CU-286/FRR-33

CU-286 checked pgs [redacted]

FRR-33 ✓ ⅜ 326

Use for R-391 schematic pg 187 188, 189, 190

INSTRUCTION BOOK

FOR

RADIO RECEIVING SET AN/FRR-33

MANUFACTURED BY
COLLINS RADIO COMPANY
ORDER NO. 21852–PHILA–50
4 MAY 1954

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WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on power input, plate, and power supply circuits.

DON'T TAKE CHANCES

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ARTIFICIAL RESPIRATION

GENERAL PRINCIPLES

1. Seconds count! Begin at once! Don't take time to move the victim unless you must. Don't loosen clothes, apply stimulants or try to warm the victim. Start resuscitation! Get air in the lungs! You may save a life!

2. Place the victim's body in a prone position, so that any fluids will drain from the respiratory passages. The head should be extended and turned sideward *never flexed forward;* the chin shouldn't sag, since obstruction of the respiratory passages may occur.

3. Remove any froth or debris from the mouth with your fingers. Draw the victim's tongue forward.

4. Begin artificial respiration. Continue it rhythmically and without any interruption until natural breathing starts or the victim is pronounced dead. Try to keep the rhythm smooth. Split-second timing is not absolutely essential.

5. When the victim starts breathing, or when additional help is available loosen the clothing; remove it, if it's wet; keep the victim warm. Shock should receive adequate attention. Don't interrupt the rhythmical artificial technique for these measures. Do them only when you have help or when natural breathing has started.

6. When the victim is breathing, adjust your timing to assist him. Don't fight his efforts to breathe. Synchronize your efforts with his. After resuscitation, keep him lying down until seen by a physician or until recovery seems certain.

7. Don't wait for mechanical resuscitation! If an approved model is available, use it, but, since mechanical resuscitators are only slightly more effective than properly performed "push-pull" manual technique, *never* delay manual resuscitation for it.

BACK-PRESSURE ARM LIFT METHOD

1. *Position of Victim.* Place the victim in the prone (face-down) position. Bend his elbows; place one hand upon the other. Turn his face to one side, placing his cheek upon his hands.

2. *Position of Operator.* Kneel on your left or right knee, at the victim's head, facing him. Your knee should be at the side of the victim's head close to his forearm, your foot should be near his elbow. Kneel on both knees if you find it more comfortable, with one knee on each side of the head. Place your hands on the flat of the victim's back so that their heels are just below the lower tip of his shoulder blades. With the tip of your thumbs touching spread your fingers downward and outward. (See A)

3. *Compression Phase.* Rock forward until your arms are approximately vertical and allow the weight of the upper part of your body to exert a slow, steady, even, downward pressure upon your hands. This forces air out of the lungs. Keep your elbows straight and press almost directly downward on the back. (See B)

4. *Expansion Phase.* Release the pressure, avoid any finish thrust, and commence to rock backward slowly. Place your arms upon the victim's arms just above the elbows, and draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the victim's shoulders.

Don't bend your elbows. As you rock backward, the victim's arms will be drawn toward you. (The arm lift expands the chest by pulling on the chest muscles, arching the back and relieving the weight on the chest.) Drop the arms gently to the ground or floor. This completes the cycle. (See C and D). Now, repeat the cycle.

5. *Cycle Timing and Rhythm.* Repeat the cycle 10 to 12 times per minute. Use a steady uniform rate of Press, Release, Lift, Release. Longer counts of about equal length should be given to the "Press" and "Lift" steps of the compression and expansion phases. Make the "Release" periods of minimum duration.

6. *Changing Position or Operator.*

(*a*) Remember that you can use either or both knees or can shift knees during the procedure, provided you don't break the rhythm. Observe how you rock forward with the back-pressure and backward with the arm-lift. The rocking motion helps to sustain the rhythm and adds to the ease of operation.

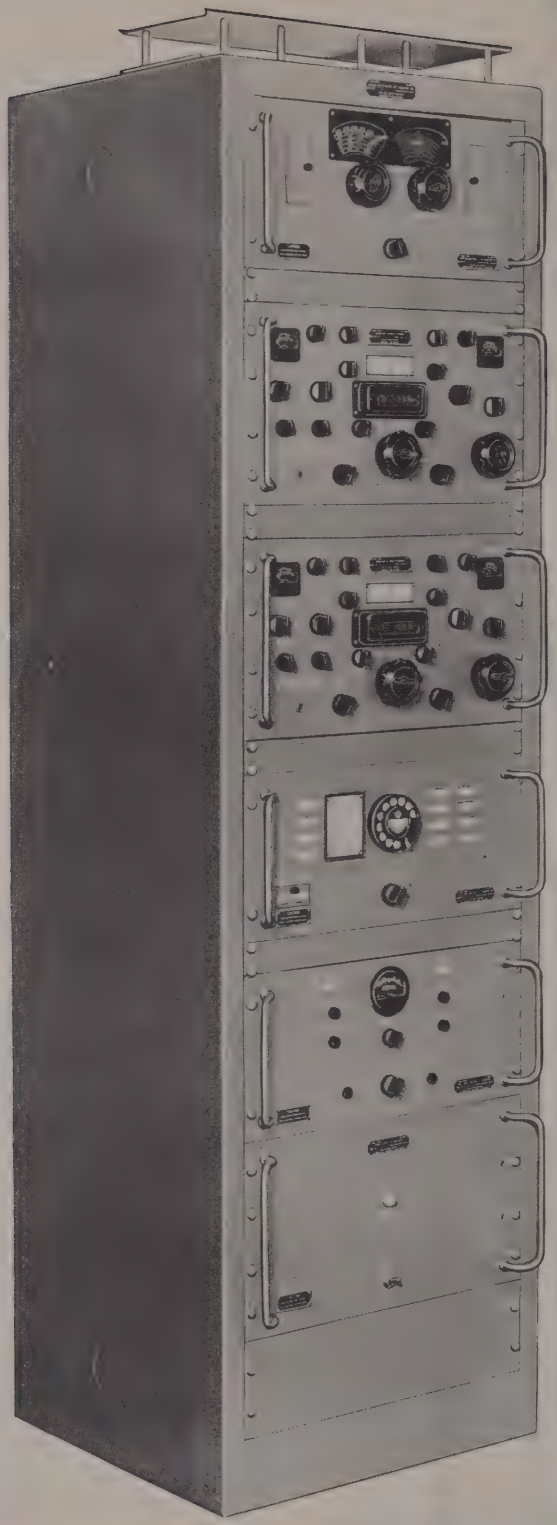
(*b*) If you tire and another person is available, you can "take turns." Be careful not to break the rhythm in changing. Move to one side and let your replacement come in from the other side. Your replacement begins the "Press-Release" after one of the "Lift-Release" phases, as you move away.

A Position of operator and victim

B Compression phase

C Expansion phase (arm lift)

D Expansion phase (arm release)



TM 871-1

Figure 1. Radio Receiving Set AN/FRR-33, local position.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This instruction book contains instructions for the installation, operation, maintenance, and repair of Radio Receiving Set AN/FRR-33.

b. In addition to an installation kit, Radio Receiving Set AN/FRR-33, includes an Antenna Coupler CU-286/FRR-33, two Radio Receivers R-391/URR, a Selector Control C-974/FRR-33, a Receiver Control C-975/URR, a Power Supply PP-629/URR, a Remote Switching Control C-973/FRR-33, and an Electrical Equipment Cabinet CY-1119/U.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army materiel and equipment.

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5 (Army), Navy Shipping Guide, Article 1850-4, and AFR 71-4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700-45-5.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AFR 65-26.

d. DA Form 11-238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 51).

e. DA Form 11-239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be filled out in accordance with instructions on the back of the form (fig. 52).

f. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose

a. Radio Receiving Set AN/FRR-33 (fig. 1) uses two identical radio receivers in conjunction with radioteletype terminal equipment to minimize the effects of fading. Two antennas are provided for each receiver in this dual-diversity system. The equipment operates over a frequency range of .5 to 32-mc (megacycles).

b. The equipment is designed to receive transmissions of frequency-shift keyed teletype signals with 850 cps shift. The resultant audio signals are used to operate the circuits of Radioteletype Terminal Equipment AN/FGC-1.

c. Two Radio Receivers R-391/URR, an Antenna Coupler CU-286/FRR-33, Selector Control C-974/FRR-33, Receiver Control C-975/URR, and Power Supply PP-629/URR are mounted in Electrical Equipment Cabinet CY-1119/U. Remote Switching Control C-973/FRR-33 may be used at a remote location to control a maximum of three Radio Receiving Set AN/FRR-33 equipment bays. A complete list of components is given in paragraph 7.

4. System Application

Figure 4 is a block diagram of a radioteletype system in which Radio Receiving Set AN/FRR-33 is used with Radioteletype Terminal Equipment AN/FGC-1( ). The distant radio transmitter sends out its normal frequency when contacts of the teletypewriter sending mechanism are closed (mark condition). When the contacts are opened (space condition), the radio frequency (rf) car-

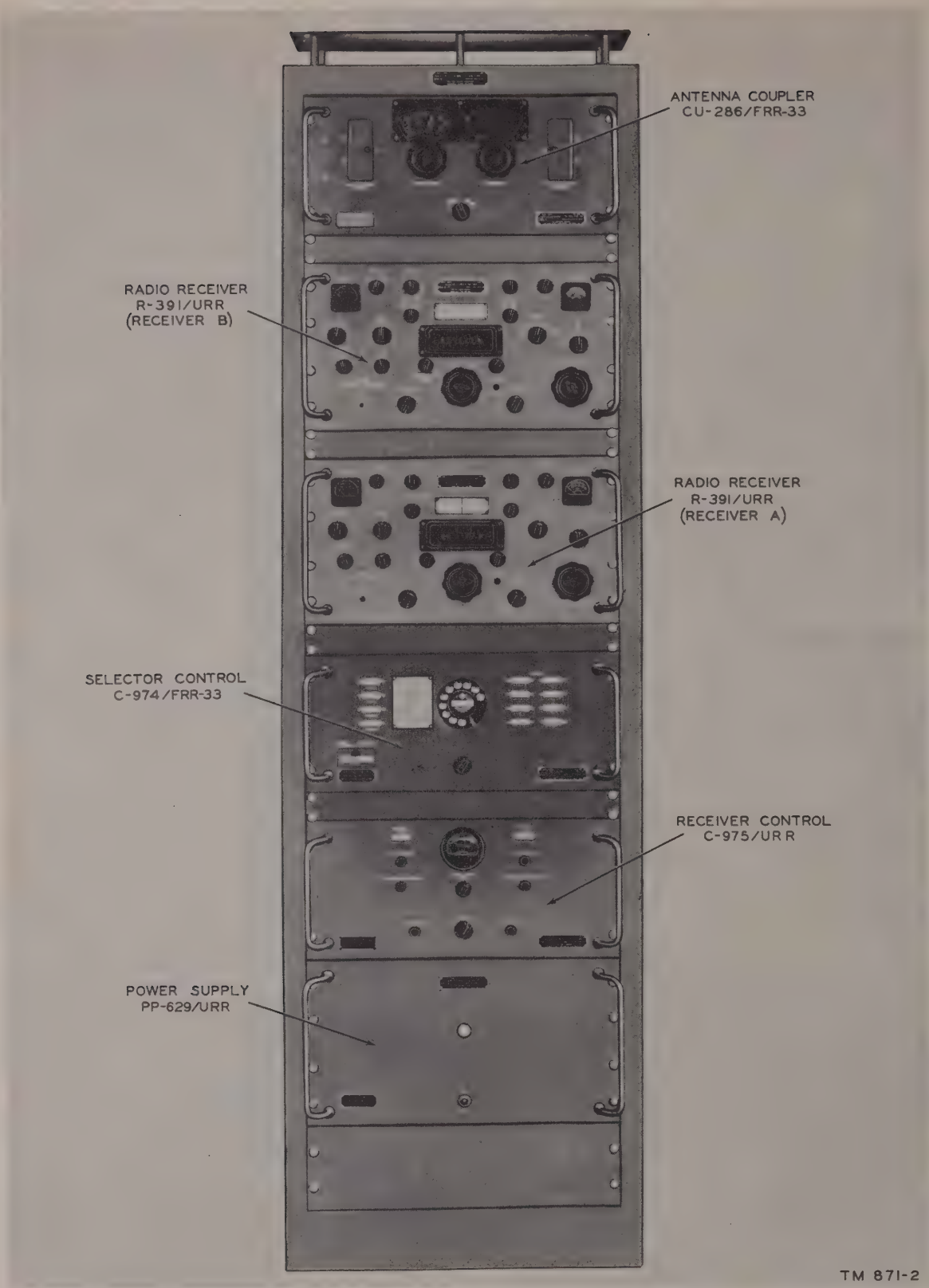


Figure 2. Radio Receiving Set AN/FRR-33, local position, front view.

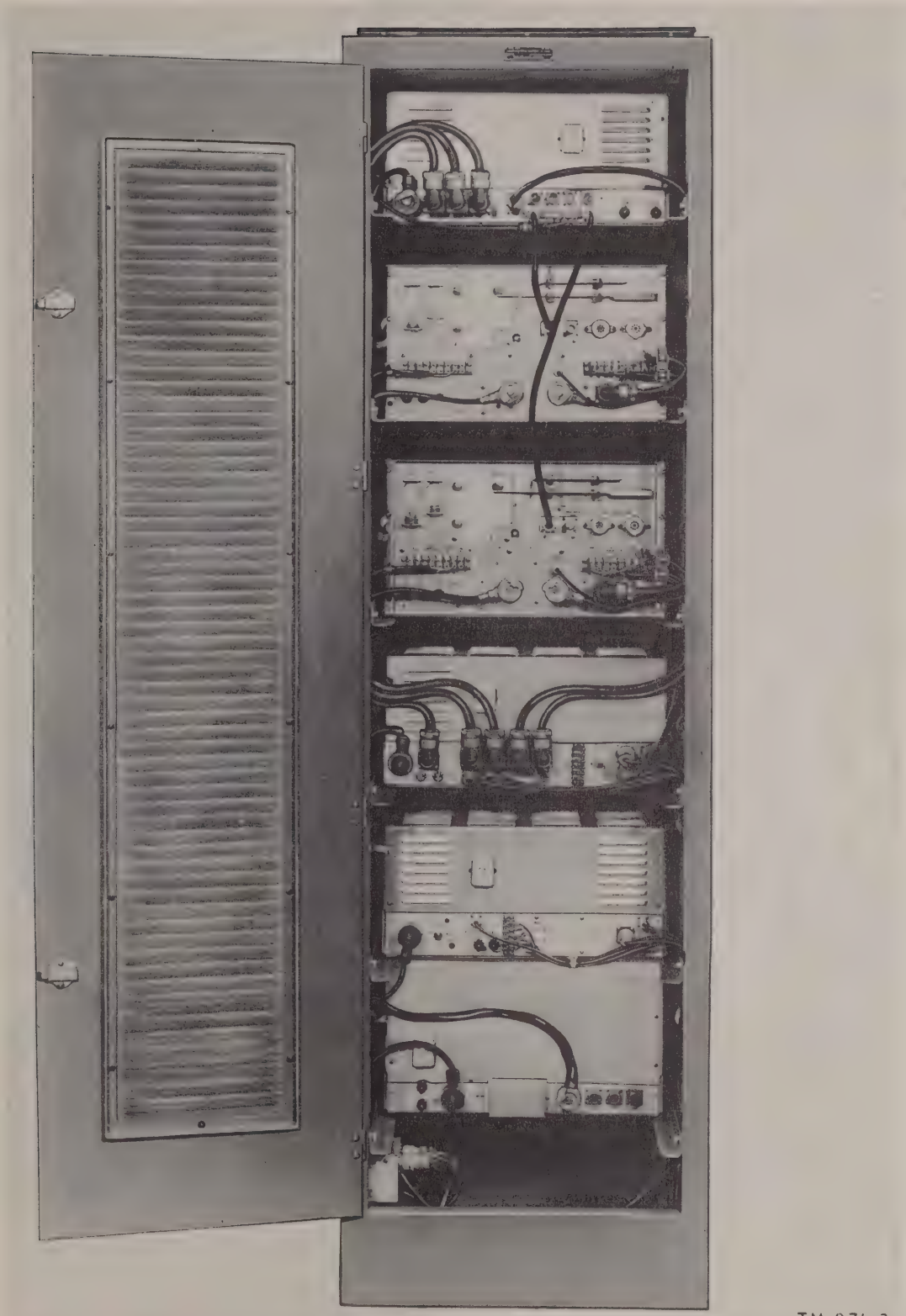


Figure 3. Radio Receiving Set AN/FRR-33, local position, rear view.

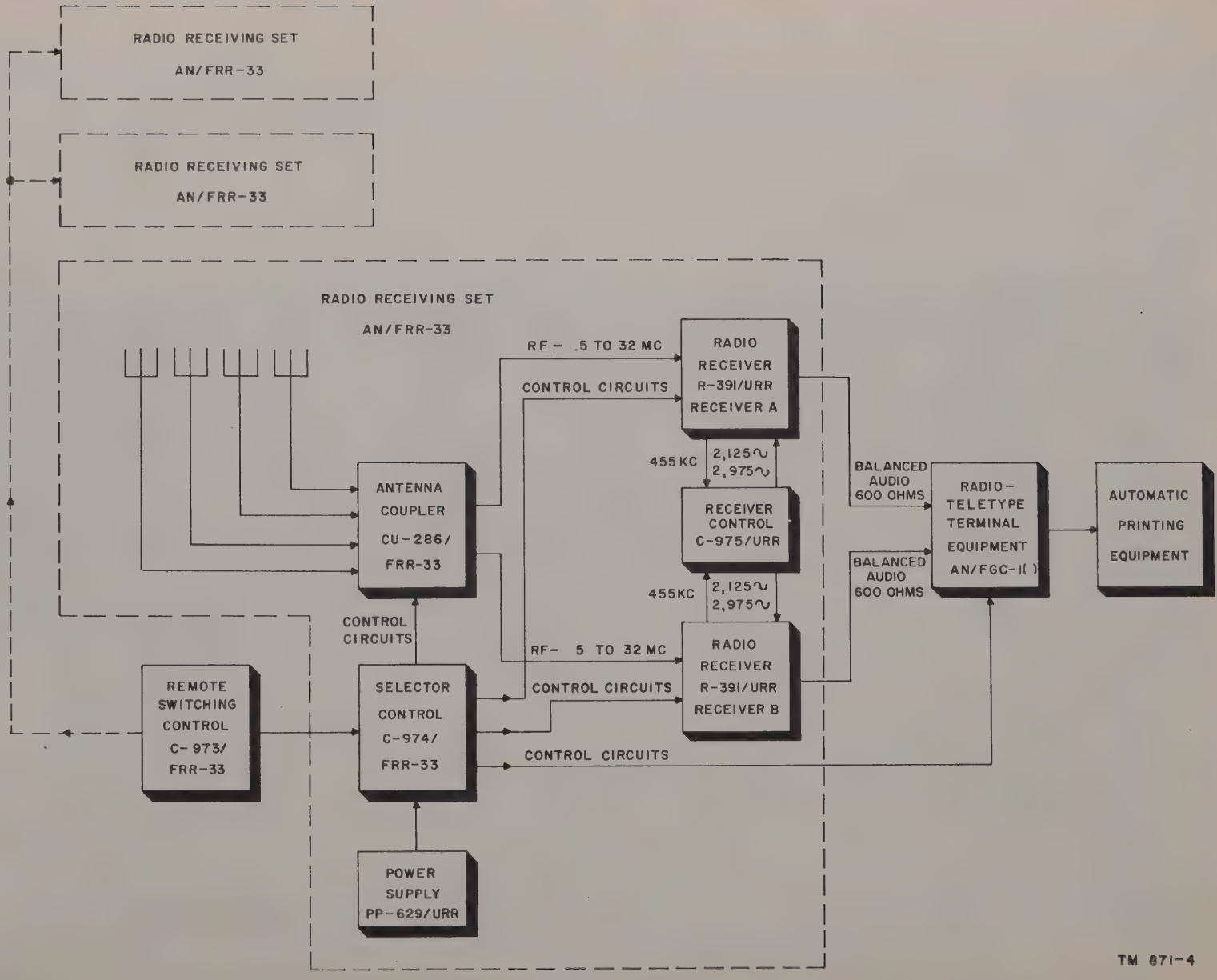


Figure 4. Radio Receiving Set AN/FRR-33, system application block diagram.

rier is reduced 850 cps in frequency, the amplitude remaining unchanged. One of two pairs of doublet or rhombic antennas feeds the incoming frequency-shift signals to Antenna Coupler CU-286/FRR-33. The antenna coupler provides circuits to couple the incoming signals to two Radio Receivers R-391/URR, matching the receiver inputs to the antenna transmission lines. Control circuits in the antenna coupler select the pair of antennas to be used. The carrier frequency of the frequency-shift signals coupled to each receiver is converted to a 455-kc intermediate frequency. The if. signal, taken from the if. output circuit of each receiver, is then fed to each channel of Receiver Control C-975/URR. The receiver control converts the if. signals to audio frequencies of 2,125 cps for *mark* signals and 2,975 cps for *space* signals. The receiver control also provides afc of the audio signals. The audio signals are then fed back to each receiver. The output signals, taken from the line audio output of Radio Receivers R-391/URR, are applied to Radioteletype Terminal Equipment AN/FGC-1( ), which provides diversity combining and produces direct-current (dc) pulses for operation of the teletypewriter printing equipment. Local control of the radio receiving set is provided by Selector Control C-974/FRR-33. The selector control contains circuits that control selection of eight channels and various functions, such as on, off, standby, etc. Power Supply PP-629/URR furnishes dc voltage to the selector control for distribution to the antenna coupler and receiver automatic tuning circuits. Remote control of a radio receiving set is provided by Remote Switching Control C-973/FRR-33. As indicated in figure 4, the remote switching control can provide control facilities for a maximum of three Radio Receiving Sets AN/FRR-33.

5. Technical Characteristics

Frequency range:

- Antenna Coupler CU-286/FRR-33:
  - Band 1 ..... .5 to 1 mc.
  - Band 2 ..... 1 to 2 mc.
  - Band 3 ..... 2 to 4 mc.
  - Band 4 ..... 4 to 8 mc.
  - Band 5 ..... 8 to 16 mc.
  - Band 6 ..... 16 to 32 mc.
- Radio Receiver R-391/URR ..... .5 to 32 mc.

Type of receiver ..... Triple conversion superheterodyne on lowest eight frequency bands, double conversion on all other bands.

Type of signals received .. Frequency-shift keyed teletypewriter signals with 850 cps shift.

Input frequency to Receiver Control C-975/URR... 455 kc (kilocycles).

Tone impulse frequency of Remote Switching Control C-973/FRR-33.... 1,105 cps ±25 cps.

Output range of Remote Switching Control C-973/FRR-33 ..... −10 dbm to +10 dbm (decibel referred to a level of 1 milliwatt in 600 ohms).

Control frequency of Selector Control C-974/FRR-33 ..... 1,105 cps ±25 cps.

Sensitivity of Selector Control C-974/FRR-33 to control impulses ..... −30 dbm.

Number of tubes:

- Antenna Coupler CU-286/FRR-33 ..... 6.
- Radio Receiver R-391/URR ..... 33 (with power supply).
- Selector Control C-974/FRR-33 ..... 8.
- Receiver Control C-975/URR ..... 35.
- Remote Switching Control C-973/FRR-33.. 7.

Type of antenna ..... Rhombic.

Power input ..... 1475 watts at 115/230 volts, 48-62 cps. (including Remote Switching Control C-973/FRR-33).

- Antenna Coupler CU-286/FRR-33 ..... 70 watts.
- Radio Receiver R-391/URR ..... 270 watts (each).
- Selector Control C-974/FRR-33 ..... 70 watts.
- Receiver Control C-975/URR ..... 135 watts.
- Power Supply PP-629/URR ..... 600 watts.
- Remote Switching Control C-973/FRR-33.. 60 watts.

Weight 1,024

6. Packaging Data

a. Packaging of Electrical Equipment Cabinet CY-1119/U. When packaged for export shipment, Electrical Equipment Cabinet CY-1119/U is packed in a moisture-vaporproof wooden export crate. The cabinet is placed in a horizontal position upon a wooden mounting base which is fastened to the base and skids of the crate by bolts. The cabinet is secured to the base by steel straps. A cushioning shroud of flexible corrugated paper, a water-vaporproof barrier, and a waterproof barrier surround the cabinet and the mounting base of the crate. Bags of desiccant and a fiberboard box which contains spare parts and accessories are fastened to the sides of the mounted cabinet.

Note. When the equipment is packaged for domestic shipment, the barriers and the desiccant are omitted. The packed crate is closed by sliding the top and sides, which are nailed together, over the cabinet and nailing them to the base and skids. The closed crate is then secured by steel straps. An exploded view of Electrical Equipment Cabinet CY-1119/U packaged for export shipment is shown in figure 24.

b. Packaging of Component Units of Radio Receiving Set AN/FRR-33. When packed for export or domestic shipment, the component units of Radio Receiving Set AN/FRR-33 are wrapped in paper and placed in an inner corrugated fiberboard carton. Each component is wrapped and packed separately. Cleated wooden spacers are used to hold the units securely within the carton and to prevent damage to the controls and connections on the front and back panels. In the space between the back panel of the receiver control and the two receivers and the rear wooden spacer are stored two instruction books, silica gel containers, and a package containing the cable assemblies shipped with the units. Running spares for the units are shipped in separate paper-wrapped fiberboard cartons. The inner corrugated fiberboard container is inclosed in a sealed, moisture-vaporproof barrier, and is placed in an outer, tight-fitting corrugated cardboard carton. This outer carton is wrapped in moisture-resistant paper sealed with tape, placed in a wooden crate containing excelsior, and secured with steel straps. An exploded view of a typical packaging arrangement of one of the component units of a radio receiving set is shown in figure 25.

c. Shipping Weights and Dimensions. When packed for export shipment, the components of Radio Receiving Set AN/FRR-33 are packed in nine crates with the following shipping weights (gross) and dimensions:

Number of crates	Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Weight (lb)	Contents
1	28	24¼	13¼		120	Receiver Control C–975/URR
2	28	24¼	13¼		110	Antenna Coupler CU–286/FRR–33 Selector Control C–974/FRR–33
2	29⅝	25⅝	19⅞		178	Radio Receivers R–390/URR
1	23½	21¼	15½		120	Power Supply PP–629/URR
1	80	23	22	23.4	188	Electrical Equipment Cabinet CY–1119/U
1	20	12	12	1.67	20	Cables
Total Weight.....					1,024	

Note. Items may be packaged in a manner different from that shown, depending upon supply channels.

7. Table of Components

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu ft)	Unit Weight (lb)
Electrical Equipment Cabinet CY–1119/U	1	78½	$20\frac{13}{16}$	21⅞	20.7	165
Antenna Coupler CU–286/FRR–33	1	8¾	16½	19	1.59	36
Radio Receiver R–391/URR	2	10½	17¼	19	2.0	80
Selector Control C–974/FRR–33	1	8¾	$15\frac{15}{16}$	19	1.53	45
Receiver Control C–975/URR	1	8¾	16½	19	1.59	48
Power Supply PP–629/URR	1	10½	14⅜	19	1.69	50
Remote Switching Control C–973/FRR–33	1	$8\frac{7}{32}$	$9\frac{31}{32}$	$12\frac{51}{64}$	.61	22
RF Cable Assembly CG–1189/U (1′9″)	1			21		
RF Cable Assembly CG–1189/U (2′6″)	1			30		

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu ft)	Unit Weight (lb)
Electrical Special Purpose Cable Assembly CX–2753/U (3′11″)	2			47		
Power Cable Assembly CX–1358/U (8′0″)	5			96		
Electrical Special Purpose Cable Assembly CX–2758/U (10′5″)	1			125		
Electrical Special Purpose Cable Assembly CX–2757/U (3′3″)	2			39		
Electrical Power Cable Assembly CX–2756/U (4′5″)	1			53		
Electrical Special Purpose Cable Assembly CX–2754/U (4′6″)	5			54		
Electrical Power Cable Assembly CX–2751/U (3′3″)	1			39		
Electrical Power Cable Assembly CX–2755/U (4′10″)	1			58		
Electrical Power Cable Assembly CX–2759/U (2′4″)	1			28		
Electrical Special Purpose Cable Assembly CX–2752/U (12′5″)	2			149		
Electrical Special Purpose Cable Assembly CX–2753/U (4′11″)	2			59		
Cord CG–409C/U (3′3″)	2			39		
Special Purpose Cable Assembly CX–2083/U (6′0″)	2			72		
Instruction books	2					
Hardware and angle brackets	1 set					
Running spares (with each component)	1 set					
Total					29.71	446

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

8. Description of Electrical Equipment Cabinet CY–1119/U

Electrical Equipment Cabinet CY-1119/U (called cabinet in text) provides a single housing and support for the components of a system such as Radio Receiving Set AN/FRR-33. The cabinet is illustrated in figures 5 and 6. Mounting screws for the units of the radio receiving set are secured in tapped holes in vertical rack channels on either side of the front opening of the cabinet. A door at the rear of the cabinet provides access to the rear of all components for changing tubes, maintenance, and adjustments. An ac power distribution channel is located on one side of the cabinet, providing eight receptacles for ac power connections. At the bottom of the distribution channel is the main ac input box, containing line fuses and an on-off switch. On the opposite side of the cabinet is a common ground bus, containing tapped holes to provide a means of securing grounding straps from the various units of the radio receiving set. The top of the cabinet is partially screened to provide ventilation, and a dust cover over the screening prevents dust from settling in the equipment. The bottom of the cabinet contains a slot through which may be brought all of the input and output connections to the equipment.

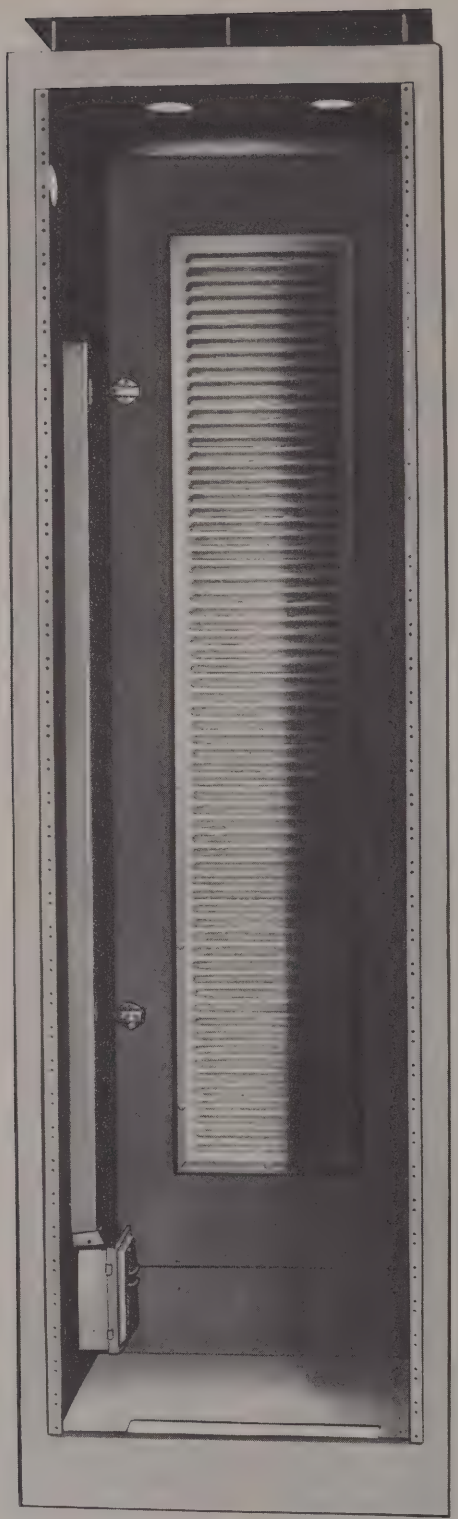


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Figure 5. Electrical Equipment Cabinet CY-1119/U, front view.

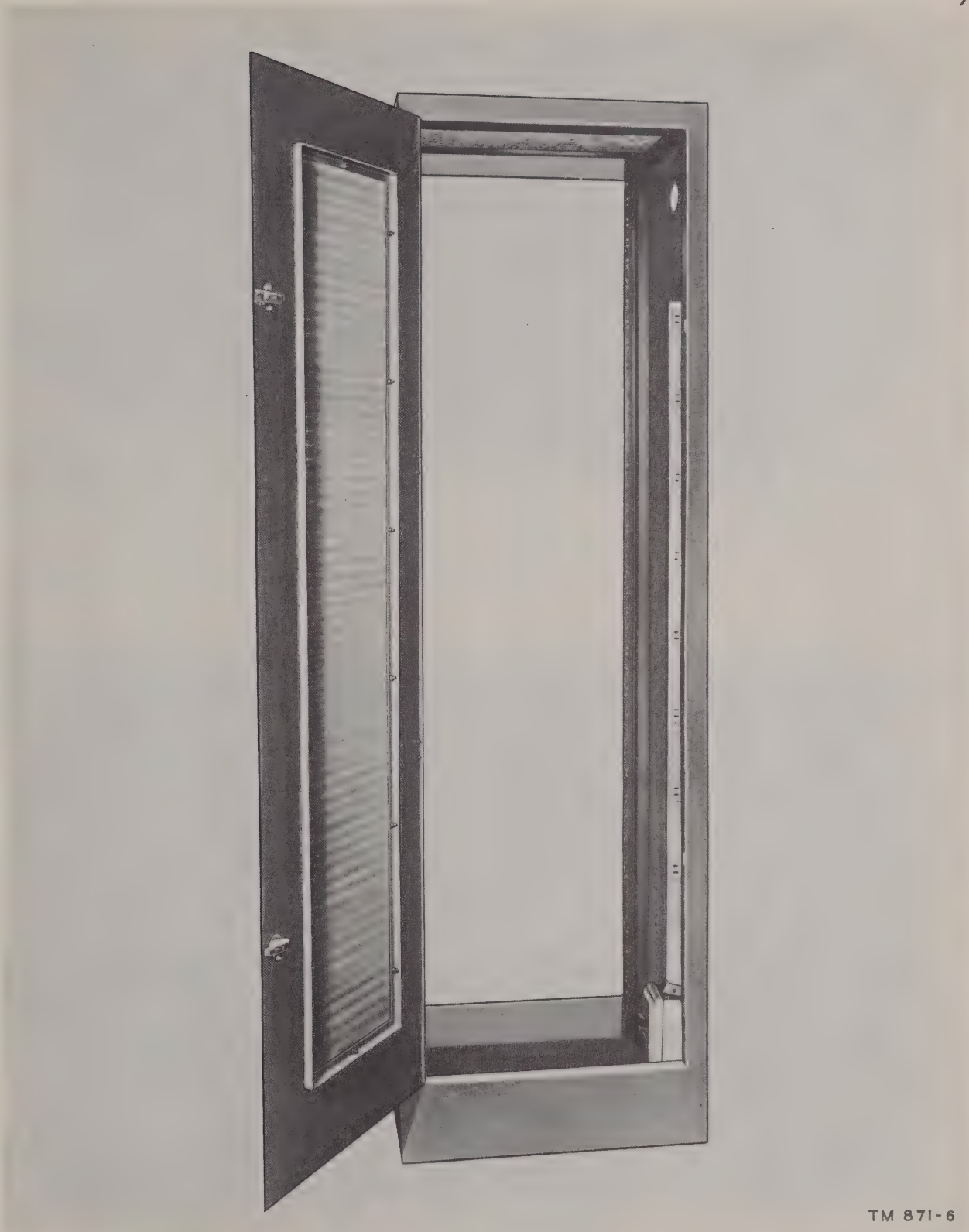


Figure 6. Electrical Equipment Cabinet CY-1119/U, rear view.

Figure 7. Antenna Coupler CU-286/FRR-33, front view.

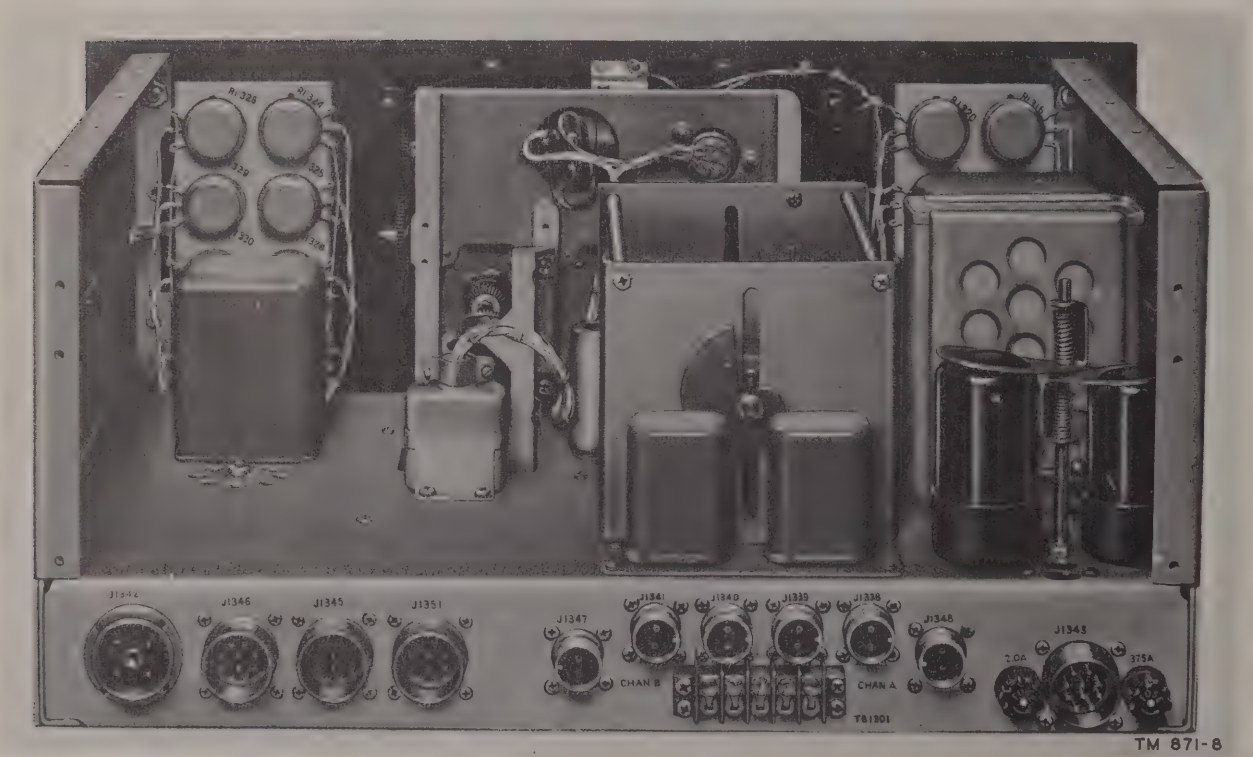


Figure 8. Antenna Coupler CU-286/FRR-33, rear view.

9. Description of Antenna Coupler CU–286/FRR–33

(figs. 7 and 8)

a. Antenna Coupler CU-286/FRR-33 (called antenna coupler in text) is a six-tube component designed to provide coupling between a diversity antenna system and two receivers. The unit operates over a frequency range of .5 to 32.0 mc. Constructed on a chassis and panel assembly, the antenna coupler is designed to mount in a standard 19-inch rack.

b. All operating controls are located on the front panel of the unit. Two handles are provided to facilitate removal and replacement of the equipment in its mounting rack. The two large knobs in the center of the front panel marked ANTENNA TUNING and TUNING RANGE are used to tune the antenna tuner to the desired frequency. Two calibrated dials above the tuning knobs indicate the band and frequency in use. Controls to adjust the rf sensitivity of the receivers are located behind two doors, one for each channel (or radio receiver), located on each side of the front panel and marked ADJUST SENSITIVITY CHANNEL A and ADJUST SENSITIVITY CHANNEL B. The function switch, marked OFF-REMOTE-ANT 1- ANT 2, is also located on the front panel.

c. On the back panel of the antenna tuner are located antenna input connectors, fuses, power and remote control connectors, output connectors, and a terminal board for connection of the receiver rf sensitivity circuits.

10. Description of Radio Receiver R–391/URR

(figs. 9 and 10)

a. Radio Receiver R-391/URR (called radio receiver in text) is a 33-tube superheterodyne receiver designed for reception of cw, voice, and radioteletype signals within the frequency range of .5 to 32 mc. The receiver is designed for mounting in a standard 19-inch rack, such as Electrical Equipment Cabinet CY-1119/U. The structural parts of the receiver are of aluminum.

b. All operating controls are located on the front panel, which has a gray semigloss finish. Two handles are provided at the outer edges of the panel to facilitate withdrawal of the receiver from the cabinet. The two large knobs at the bottom of the panel marked MEGACYCLE CHANGE and KILOCYCLE CHANGE are used to tune the receiver to the desired frequency. Above the KILOCYCLE CHANGE control is a counter-type frequency indicator. The numbers shown indicate the frequency in kilocycles. The two left-hand number wheels of the center are operated by the MEGACYCLE CHANGE control; the three right-hand number wheels are operated by the KILOCYCLE CHANGE control. The operation of these controls, once having been preset, is under control of the CHANNEL SELECTOR switch, located on the left-hand side of the panel. This control is an eight-position for automatic selection (through the use of Autotune mechanism) of any one of eight preset frequency channels.

Figure 9. Radio Receiver R-391/URR, front view.

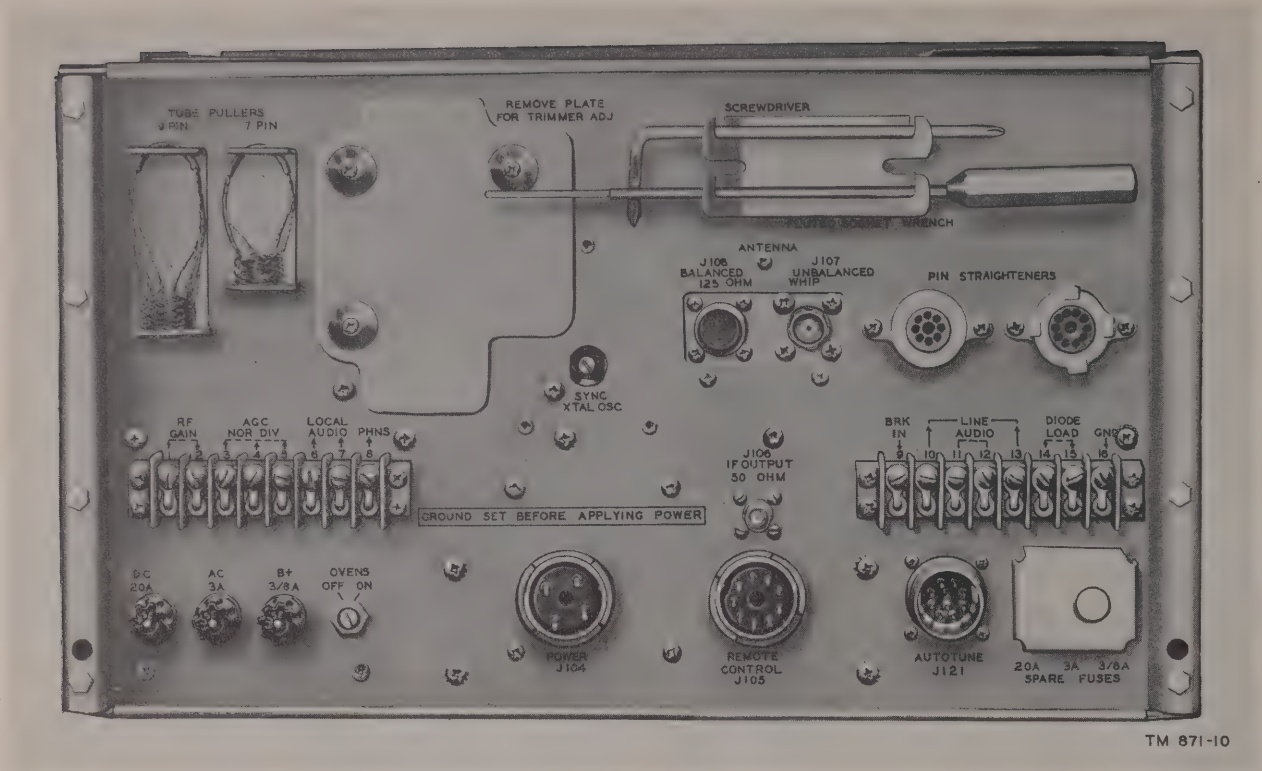


Figure 10. Radio Receiver R-391/URR, rear view.

Both the MEGACYCLE CHANGE and KILOCYCLE CHANGE control knobs have locking keys. These keys are always locked when using automatic tuning. In the upper left-hand corner of the front panel is a meter for indicating the level in vu (volume units) of the line audio output of the receiver. The CARRIER LEVEL meter, in the upper right-hand corner of the panel, indicates the relative strength of incoming signals and signal peaks. Distributed about the panel are 16 bar-knobs which control the various functions of the receiver. These controls include the LINE METER on-off and range switch, LINE GAIN control, AGC time-constant switch, LIMITER on-off switch and threshold control, AUDIO RESPONSE selector switch, BREAK IN circuit OFF-ON switch, BANDWIDTH selector switch, BFO (beat-frequency oscillator) PITCH control, FUNCTION switch, ANT. TRIM (antenna trimmer) control, CHANNEL SELECTOR switch, BFO OFF-ON switch, AUTOTUNE REMOTE-LOCAL switch, frequency-indicator zero-adjustment (ZERO ADJ.) control, LOCAL GAIN control, and RF GAIN control. The PHONES jack in the lower left-hand corner of the panel is provided for connecting a pair of headphones to the receiver local audio output. Directly below the ZERO ADJ. control is located an opening, identified as CHANNEL, through which is seen a channel indicator. After a channel has been selected by the CHANNEL SELECTOR switch, and the Autotune mechanism comes to a stop, this indicator shows what channel is being used.

c. On the back panel of the radio receiver are mounted special tools, antenna input connectors, operating and spare fuses, power and remote control connectors, and if. output connector, and OVENS OFF-ON control, terminal boards for connection of external circuits, and, under a protective cover, trimmer adjustments for the crystal oscillators.

d. Radio Receiver R-391/URR is comprised of a number of replaceable assemblies. The rf, if., and crystal-oscillator sub-chassis are mounted on the upper deck of the main frame. Mounted in three compartments on the

lower deck are the vfo (variable-frequency oscillator) subchassis, af subchassis, calibration-oscillator subchassis, and Power Supply PP-621/URR. The subchassis are connected to the main frame and/or to each other by cables terminating in locking-type connectors. Mounted on the rf subchassis are the gears, camshafts, and racks of the mechanical tuning system. Mounted on the main frame is a casting to which is attached the parts of the Autotune tuning system.

11. Description of Selector Control C–974/FRR–33

(figs. 11 and 12)

a. Selector Control C-974/FRR-33 (called selector control in text) resembles the Antenna Coupler CU-286/FRR-33. In general mechanical construction, it is built on a chassis and panel for rack mounting, operating controls are mounted on the front panel, and the plate voltage power supply is self-contained. The selector control is an eight-tube component designed to provide local control and selection of the various channels and functions of Radio Receiving Set AN/FRR-33.

b. A telephone-type dial located in the center of the front panel is used to select the various functions and channels indicated on the chart beside the dial. Twelve lights on the front panel indicate operation of the equipment. An OFF-REMOTE-LOCAL switch, used to select remote or local operation, is located below the dial. A door on the lower left side of the front panel provides access to two controls: the ADJUST SENSITIVITY control used to adjust the incoming signal level from Remote Switching Control C-973/FRR-33, and the BAY PREFIX SELECTOR switch used to set the bay prefix for use of the selector control with remote control.

c. Located on the rear panel of the selector control are the following controls: EXT-INT switch to select normal operation or operation with an external impulse source; fuses F1401 and F1402 to provide equipment protection; terminal board TB1401 to provide input connections for a 600-ohm telephone line; terminal board TB1404 to provide facilities for external pulse control; an input power connector; and connectors to provide various control facilities.

Figure 11. Selector Control C-974/FRR-33, front view.

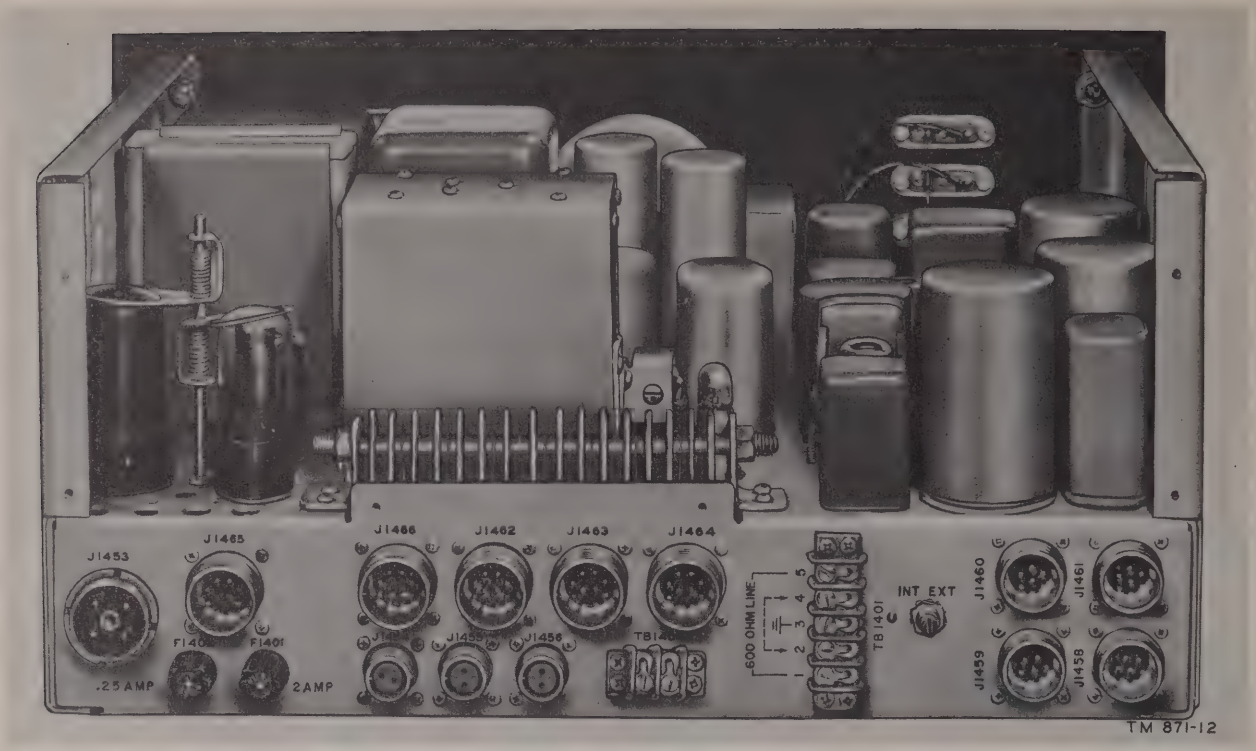


Figure 12. Selector Control C-974/FRR-33, rear view.

12. Description of Receiver Control C–975/URR

(figs. 13 and 14)

a. Receiver Control C-975/URR (called receiver control in text) is a 35-tube component designed to provide an afc (automatic frequency control) circuit in radioteletype systems. The equipment consists of a front panel and chassis constructed for rack mounting. All operating controls are located on the front panel. The panel also contains two handles to facilitate removal and replacement of the unit. A bottom dust cover is held in place by Phillips-head screws; a top dust cover is held in place by a combination of Phillips-head screws and Dzus fasteners.

b. For each channel a number of controls are mounted on the front panel. These include the following: A CHANNEL A (or B) AFC ON indicator lamp, AFC THRESHOLD control, DISCRIMINATOR FREQUENCY control, and AFC DISCHARGE control. Also mounted on the front panel is METER SWITCH A-OFF-B, which places a meter in one of the afc channels to indicate the approximate correction (in kc) provided by the selected channel. The OFF-BFO-AFC function control switch also is located on the front panel.

c. The following controls are located on the rear of the chassis: IF INPUT CHANNEL A receptacles J1567, IF INPUT CHANNEL B receptacle J1568, operating fuses F1501 3 AMP and F1502 .375 AMP, ADJUST FILAMENT control R1646, power input receptacle J1570, a test jack J1577 for the regulated filament voltage (6.3 V RMS), a meter zero adjustment (METER ZERO), a receptacle (J1571) for the control cable that supplies ground circuit to the relay power supply, and a terminal board that supplies connection points to the detector diode load circuits of the companion receivers.

d. A B+ 180V test jack (J1569) is provided on the top of the chassis.

Figure 13. Receiver Control C-975/URR, front view.

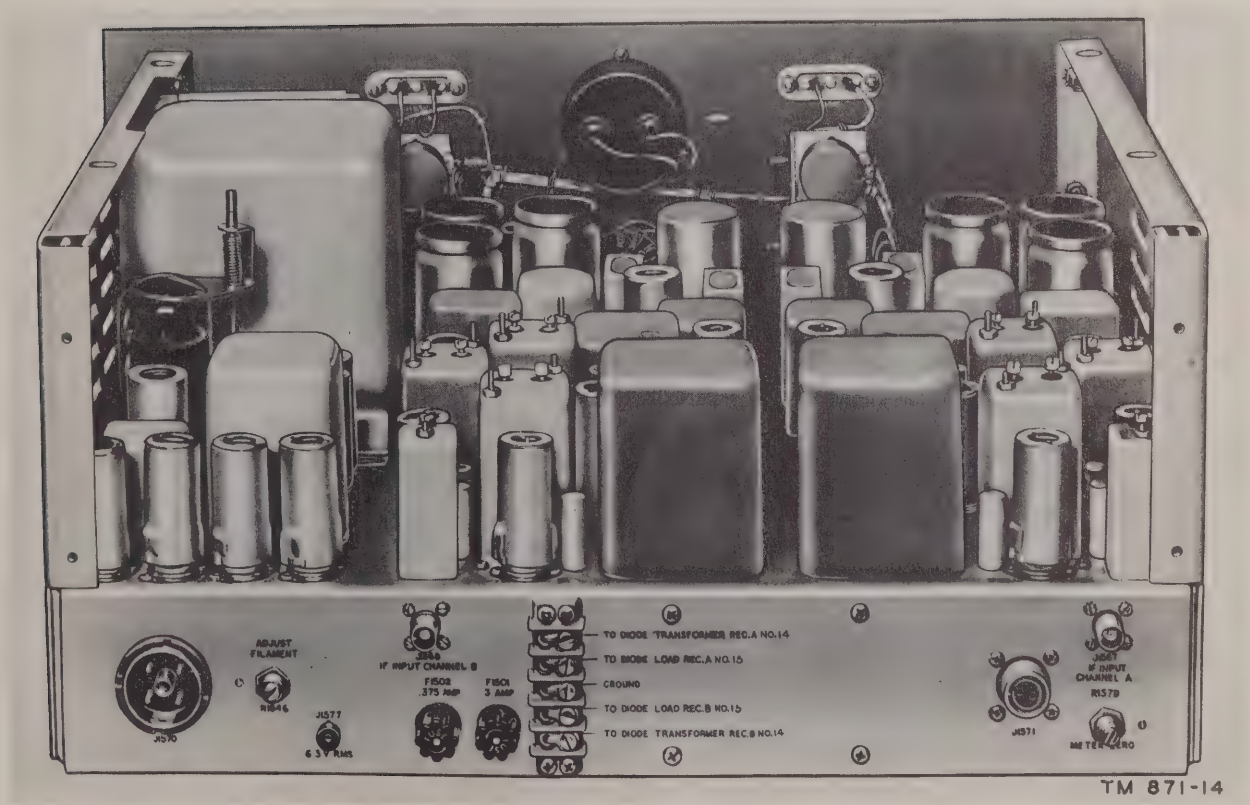


Figure 14. Receiver Control C-975/URR, rear view.

Figure 15. Power Supply PP-629/URR, front view.

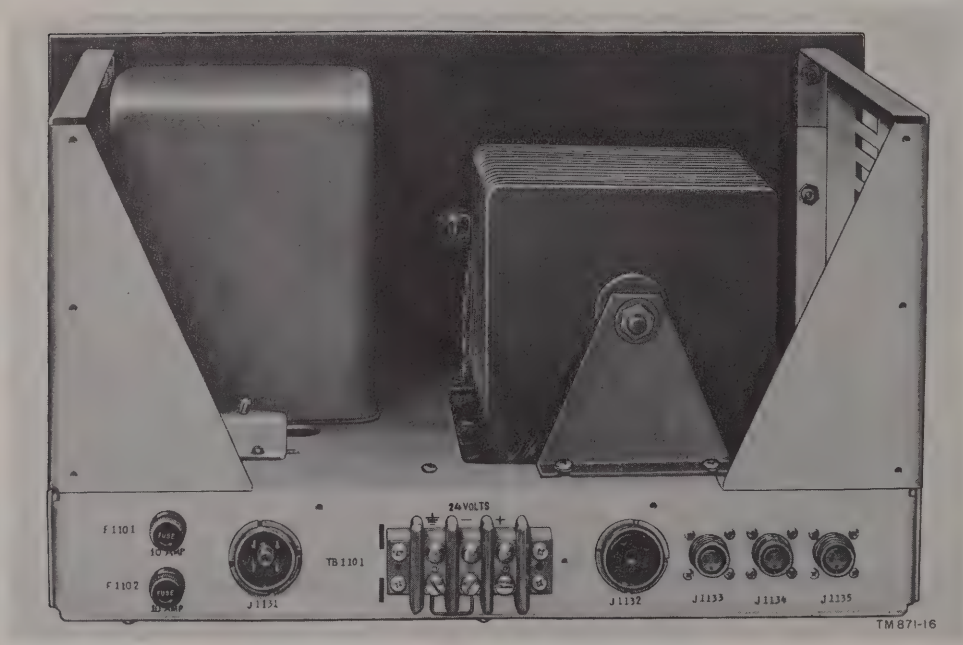


Figure 16. Power Supply PP-629/URR, rear view.

13. Description of Power Supply PP–629/URR
(figs. 15 and 16)

Power Supply PP-629/URR (called power supply in text), consisting of a power transformer, selenium rectifier and associated circuitry, is housed within a grey semigloss enamel finished case. This supply furnishes the 24-volt dc voltage for use with the Autotune circuits in Radio Receiving Set AN/FRR-33. Power Supply PP-629/URR operates from a 115- or 230 volt ac source. A switch on the top of the chassis can be locked in the proper position to connect input power from either 115-volt or 230-volt operation. The switch on the front panel is used as the ON-OFF switch for the unit. On the rear of the unit are located the input power connector and several connectors to provide 24 volts dc and 115 volts ac to external equipment.

14. Description of Remote Switching Control C–973/FRR–33
(figs. 17 and 18)

Remote Switching Control C-973/FRR-33 (called remote switching control in text) is constructed as a self-contained unit for location at some position remote from the radio receiving set which it controls. It contains circuits providing selection of any function or channel of the radio receiving set. A voltage regulated power supply is contained within the unit. Mounted on the front panel is a dial to provide a means of selecting the functions indicated by the chart adjacent to the dial, a POWER lamp to indicate application of power, a TUNING IN PROGRESS lamp to indicate functioning of the selector circuits, and the OFF-STDBY-ON switch. On the rear of the unit are located the following controls: OUTPUT LEVEL control R1205 to adjust the output level of the unit; TONE EXT-INT control to select remote or local tone operation of the unit; fuses; and terminal boards TB1201 and TB1205 to provide connection to a 600-ohm telephone line and a source of external tone, respectively.

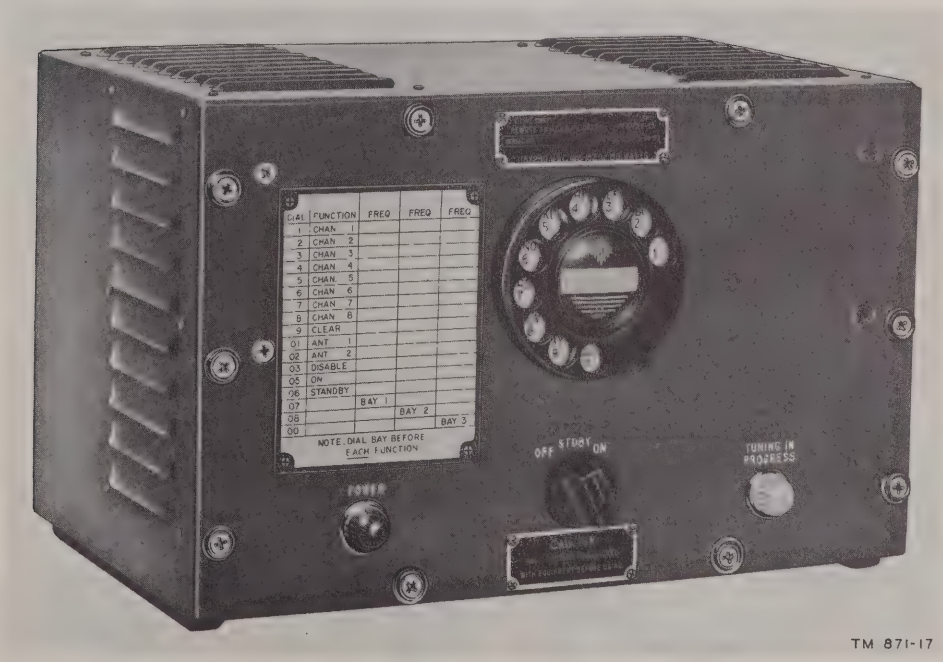


Figure 17. Remote Switching Control C-973/FRR-33, front view.

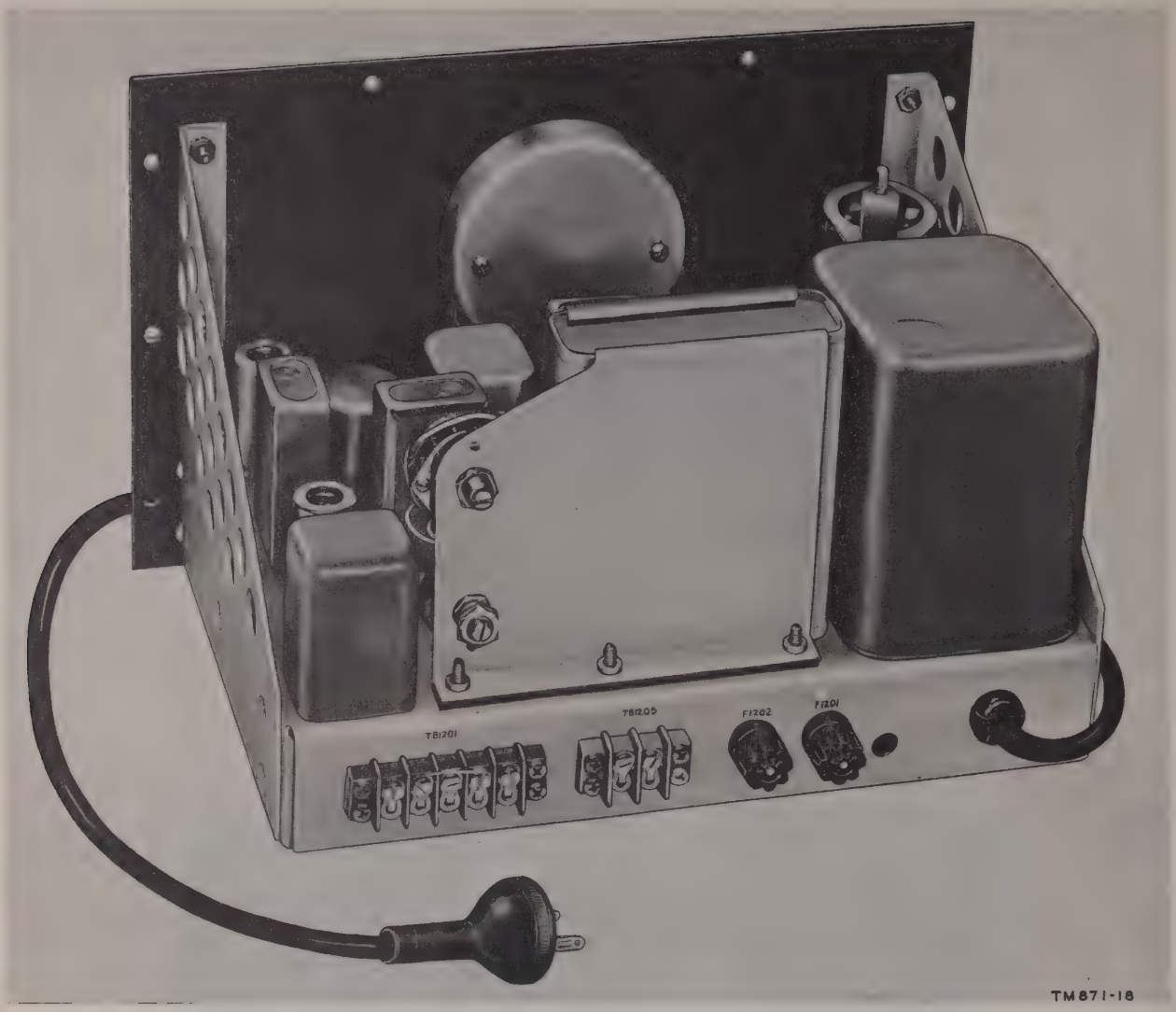


Figure 18. Remote Switching Control C-973/FRR-33, rear view.

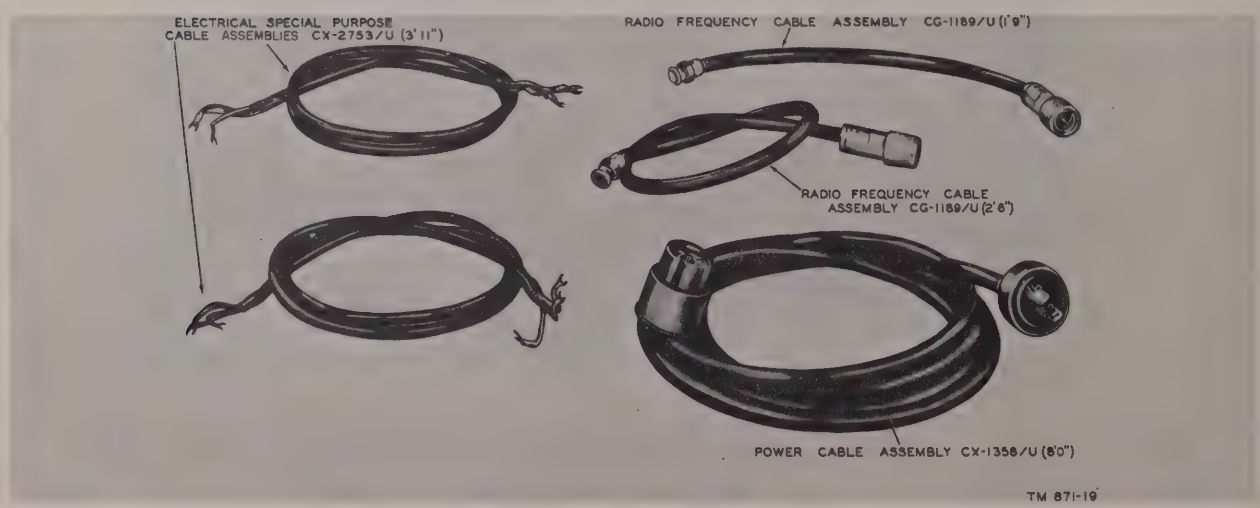

ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLIES CX-2753/U (3'11")
RADIO FREQUENCY CABLE ASSEMBLY CG-1189/U (1'9")
RADIO FREQUENCY CABLE ASSEMBLY CG-1189/U (2'6")
POWER CABLE ASSEMBLY CX-1358/U (8'0")
TM 871-19

Figure 19. Cable assemblies supplied with antenna coupler.

15. Cable Assemblies

(figs. 19, 20, and 21)

a. Antenna Coupler CU-286/FRR-33. Five cable assemblies, as described below, are supplied for use with Antenna Coupler CU-286/FRR-33.

(1) *Power Cable Assembly CX-1358/U.* The ac power cable supplied with the antenna coupler is made up of an 8-foot, two-conductor cable terminated in a screw-locking plug at one end and a standard parallel-prong ac plug at the other end. The screw-locking plug has a center lead screw fan securing the cable plug to the input power connector of the antenna coupler.

(2) *Radio Frequency Cable Assembly CG-1189/U.* This cable, used to couple the rf output of the unit to receiver A consists of a 30-inch length of coaxial Cable RG-62B/U terminated at each end in a Plug UG-627/U and a Plug UG-971/U modified for securing the cable.

(3) *Radio Frequency Cable Assembly CG-1189/U.* This cable, used to couple rf output to receiver B, is similar to (2) above with the exception of a shorter length of coaxial cable, 21 inches in this case.

(4) *Electrical Special Purpose Cable Assembly CX-2753/U.* Two of these cables are supplied. The rf sensitivity controls of the two receivers are connected to the antenna coupler with these cables. Each cable consists of a 47-inch length of two-conductor, rubber-covered, shielded cable, terminated in both ends with spade lugs.

b. Radio Receiver R-391/URR. Two cables are supplied with each receiver, a Power Cable Assembly CX-1358/U as described in subparagraph *a* (1) above, and Electrical Special Purpose Cable Assembly CX-2083/U, which consists of a 72-inch length of two-conductor cable terminated in one end with a screw-locking plug and a male plug at the other end. The screw-locking plug employs a center lead screw for securing the cable to the REMOTE CONTROL connector of the receiver.

c. Selector Control C-974/FRR-33. Fourteen cables are supplied with the selector control. These are described below.

(1) *Electrical Power Cable Assembly CX-2758/U.* This cable, consisting of a 125-inch, two conductor cable terminated in tinned leads at one end and a plug at the other end, connects control circuits of the selector control to Radioteletype Terminal Equipment AN/FGC-1.

(2) *Electrical Special Purpose Cable Assembly CX-2757/U.* Two cables are provided to connect control circuits of the selector control to break-in circuits of each receiver. Each consists of a 39-inch length of two-conductor, rubber-covered, shielded cable terminated in spade lugs at one end and a plug at the other end.

(3) *Electrical Power Cable Assembly CX-2756/U.* Provides connection between function control circuits of selector control and antenna coupler. The cable consists of a 53-inch, 4-conductor, rubber-covered cable with female connectors at each end.

(4) *Electrical Special Purpose Cable Assembly CX-2754/U.* Five of these cables are used to connect the Autotune control circuits of the selector control to the Autotune and rf sensitivity circuits in the antenna coupler, and receivers. Each cable is a 54-inch, 10-conductor, rubber-covered cable with identical plugs at each end.

(5) *Electrical Power Cable Assembly CX-2751/U.* Power from Power Supply PP-629/URR is applied to the selector control through this cable. It consists of a 4-conductor, rubber-covered cable, 39 inches in length, terminated in a female plug at one end and a male plug at the other end.

(6) *Electrical Power Cable Assembly CX-2755/U.* This cable connects control circuits of the selector control to the junction box in the radio receiving set. The circuits control functions in Radioteletype Terminal Equipment AN/FGC-1( ). The cable is a 58-inch, 6-conductor, rubber-covered cable terminated in a plug at each end.

(7) *Electrical Power Cable Assembly CX-2759/U.* This cable provides connections between the selector control and receiver control to give afc muting action of the receiver control curing selector functioning. The cable is a 2-conductor, rubber-covered cable, 35 inches in length, terminated in a male connector at each end.

(8) *Electrical Special Purpose Cable Assembly CX-2752/U.* Two cables provide connection of the audio output of the receivers to the radioteletype terminal equipment. Each cable is a 149-inch shielded cable with two conductors. One end is terminated in tinned leads and the other in spade lugs.

d. Receiver Control C-975/URR. Five cables are supplied with the receiver control, as follows:

(1) *Power Cable Assembly CX-1358/U.* Described in subparagraph *a*(1) above.

(2) *Cord CG-409C/U.* Two cables are supplied, one for each receiver, to connect the if. output

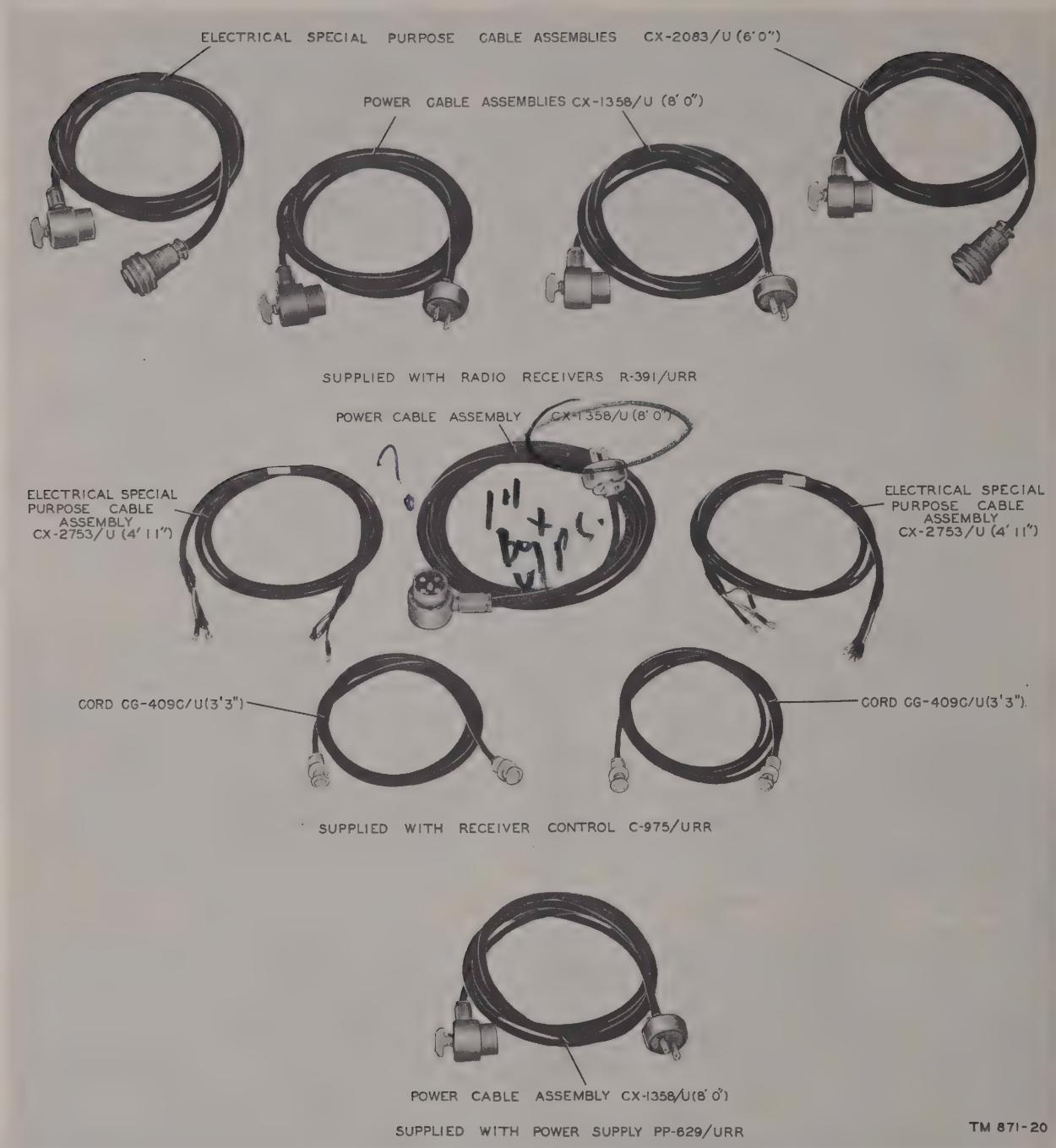

ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLIES CX-2083/U (6' 0")
POWER CABLE ASSEMBLIES CX-1358/U (8' 0")
SUPPLIED WITH RADIO RECEIVERS R-391/URR
POWER CABLE ASSEMBLY CX-1358/U (8' 0")
ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLY CX-2753/U (4' 11")
ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLY CX-2753/U (4' 11")
CORD CG-409C/U(3'3")
CORD CG-409C/U(3'3")
SUPPLIED WITH RECEIVER CONTROL C-975/URR
POWER CABLE ASSEMBLY CX-1358/U(8' 0")
SUPPLIED WITH POWER SUPPLY PP-629/URR
TM 871-20

Figure 20. Cable assemblies supplied with radio receivers, receiver control, and power supply.

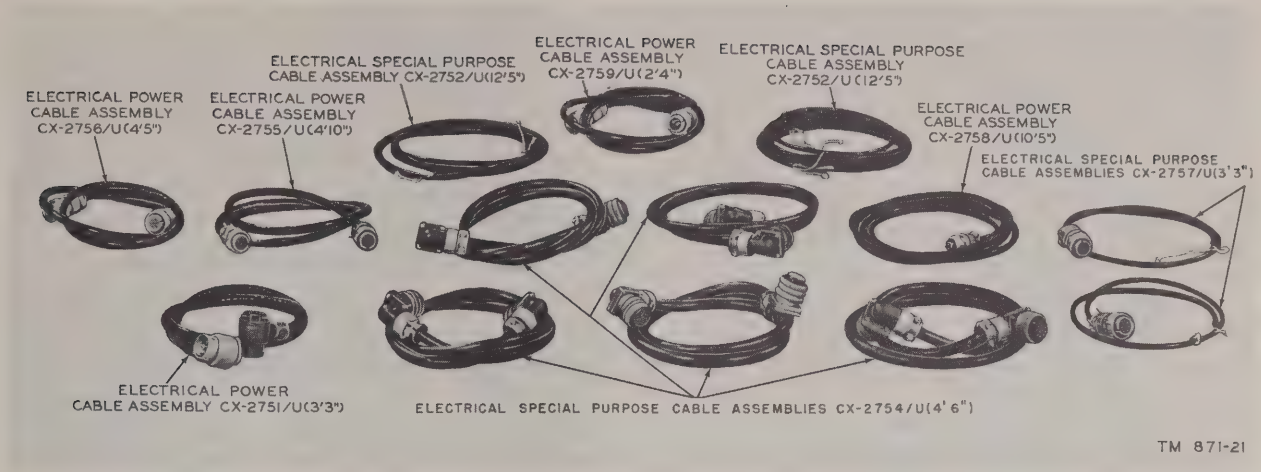

ELECTRICAL POWER CABLE ASSEMBLY CX-2756/U(4'5")
ELECTRICAL POWER CABLE ASSEMBLY CX-2755/U(4'10")
ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLY CX-2752/U(12'5")
ELECTRICAL POWER CABLE ASSEMBLY CX-2759/U(2'4")
ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLY CX-2752/U(12'5")
ELECTRICAL POWER CABLE ASSEMBLY CX-2758/U(10'5")
ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLIES CX-2757/U(3'3")
ELECTRICAL POWER CABLE ASSEMBLY CX-2751/U(3'3")
ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLIES CX-2754/U(4'6")
TM 871-21

Figure 21. Cable assemblies supplied with selector control.

of the receiver to the receiver control. Each consists of a 39-inch length of coaxial Cable RG-58C/U terminated at each end with a Plug UG-88/U.

(3) *Electrical Special Purpose Cable Assembly CX-2753/U.* Two cables, one for each receiver, couple the audio output of the receiver control to the receivers. Each cable is a 59-inch, two-conductor, rubber-covered cable terminated at both ends in spade lugs.

e. Power Supply PP-629/URR. Power Cable Assembly CX-1358/U, described in subparagraph *a*(1) above, is supplied with the power supply.

16. Running Spares

a. General. The running spares supplied with each component of the radio receiving set are given in the following subparagraphs. For a complete list of the spares shipped with the receivers and receiver control, see the instruction books supplied with those units.

b. Antenna Coupler CU-286/FRR-33.

2 tubes, type 5686
1 tube, type 6AU6
1 tube, type 6082
1 tube, type 5651
1 tube, type 5Y3WGT
2 bulbs, 6-volt
5 fuses, 3/8 ampere, type 3AG
5 fuses, 2 ampere, type 3AG

c. Radio Receiver R-391/URR. The following is a list of running spares shipped with each receiver:

2 tubes, type 3TF7
6 tubes, type 6AJ5
2 tubes, type 6AK6
1 tube, type 6BH6
3 tubes, type 6BJ6
6 tubes, type 6C4W
1 tube, type 12AT7
3 tubes, type 12AU7
1 tube, type 26Z5W
1 tube, type 5651
4 tubes, type 5749/6BA6W
1 tube, type 6082
4 dial lamps, type GE 327
6 fuses, 3/8-ampere, type 3AG
6 fuses, 3-ampere, type 3AG

d. Selector Control C-974/FRR-33.

1 tube, type 6C4
1 tube, type 6AK6
2 tubes, type 6AU6
1 tube, type 12AX7
1 tube, type 6082
1 tube, type 5651
1 tube, type 5Y3WGT
4 lamps, pilot
5 fuses, 1/4-ampere, type 3AG
5 fuses, 2-ampere, type 3AG

e. Receiver Control C-975/URR. The following is a list of running spares shipped with each receiver:

1 tube, type 2D21W
1 tube, type 3A4
2 tubes, type 6C4
1 tube, type 6J4
1 tube, type 12AX7
2 tubes, type 12AU7
1 tube, type 26Z5W
1 tube, type 6082
2 tubes, type 6BJ6
1 tube, type 5651
4 tubes, type 6BH6
1 tube, type 5654/6AK5W
1 lamp, neon; Littelfuse #9
5 fuses, 3/8 ampere, type 3AG
5 fuses, 3 ampere, type 3AG

f. Remote Switching Control C-973/FRR-33.

2 tubes, type 6AK6
1 tube, type 6AU6
1 tube, type 6082
1 tube, type 5651
1 lamp, neon, type NE-51
5 fuses, 1/4-ampere, type 3AG
5 fuses, 2-ampere, type 3AG

17. Additional Equipment Required

The following equipment and materials are not supplied as part of Radio Receiving Set AN/FRR-33 but are required for its installation and operation: complete diversity antenna system, an ac power source, teletypewriter equipment such as Radioteletype Terminal Equipment AN/FGC-1( ), teletypewriter printing equipment, and a 600-ohm headset such as Navy type CW-49507, or equivalent.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

18. Siting
(figs. 22 and 23)

a. External Requirements. The best location for Radio Receiving Set AN/FRR-33 depends on the various local conditions. The following conditions may influence the requirements: the type of housing available, the terrain, the need for easy access to messengers, etc. Best communication results when Radio Receiving Set AN/FRR-33 can be operated in a high open location with no hills or large structures between points of communication. Avoid operation near steel structures, dense woods, or other obstructions. Flat ground is desirable. Transmission over water is normally better than transmission over land. Avoid locations where drainage conditions may lead to flooding of the shelter. Figures 22 and 23 illustrate bad and good siting conditions. Two pair of antennas are used with the equipment. A spacing of 600 feet between the antennas is considered optimum.

Figure 22. Bad siting conditions.

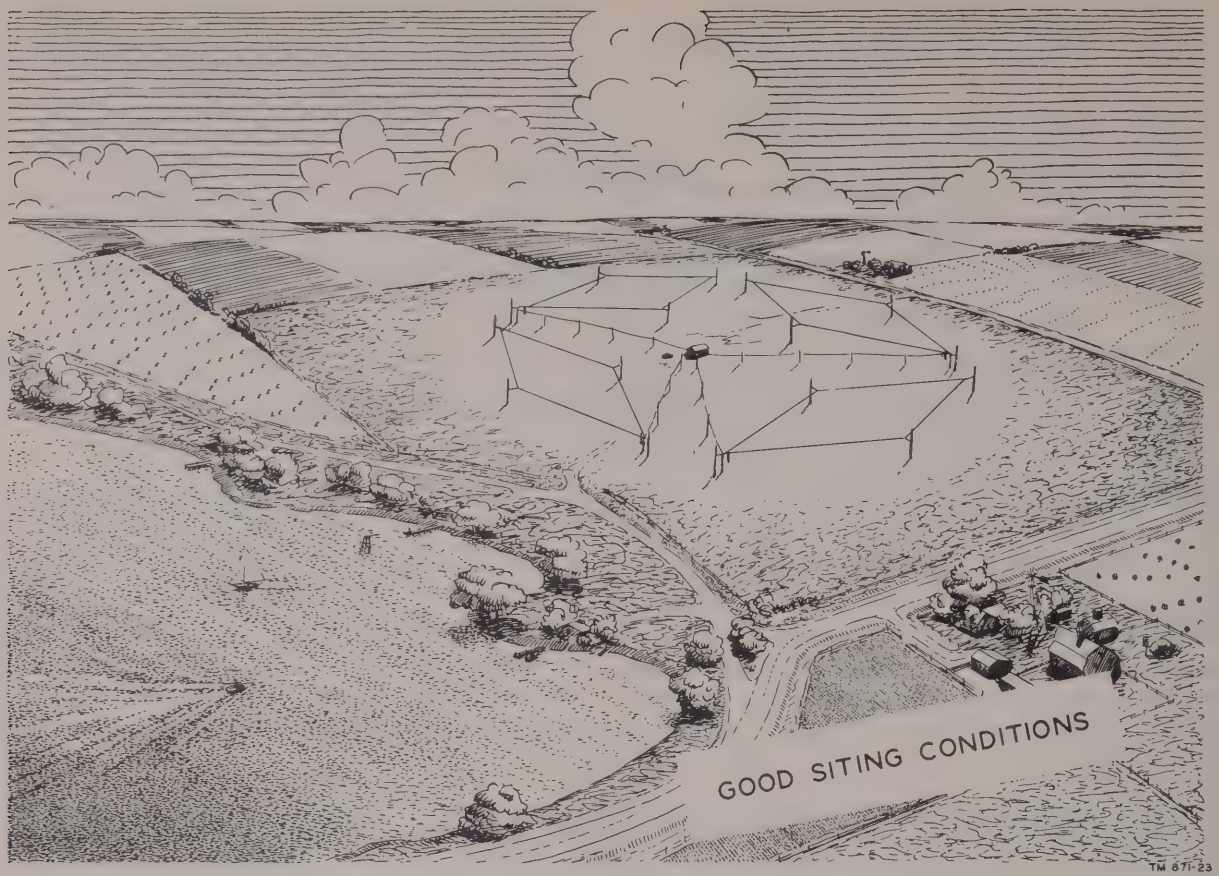


Figure 23. Good siting conditions.

b. Internal Requirements. The shelter for the equipment must meet the following requirements:

(1) The floor must be capable of withstanding the weight of the equipment in a level position (par. 7).

(2) There must be a ceiling height sufficient to permit permanent vertical installation of the equipment (par. 7).

(3) Sufficient space must be allowed behind the cabinet to open the door and sufficient space must be provided on one side so that it is possible to walk to the rear of the cabinet.

(4) Provisions must be made to either locate the auxiliary printing equipment used with the radio receiving set close to the equipment or to provide facilities for the interconnecting cables.

(5) Sufficient space must be available for possible repair work.

(6) Adequate lighting for day and night operation must be provided. Position the cabinet so that the panel designations may be read easily by the operating personnel. Artificial lighting should be accomplished with light bulbs so placed that the light falls directly upon the panel. A portable drop lamp and extension cord are convenient assets for operating and maintenance personnel.

(7) Adequate ventilation must be provided. If necessary, remove dust covers of each unit and the black panels.

19. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 23.

a. General. The electrical equipment cabinet may be shipped in overseas or domestic packing cases. In both cases, the cabinet is shipped in a wooden crate. The component units of the radio receiving set are packed identically for both export and domestic shipment. When the equipment is received, select a location where the equip-

ment may be unpacked without exposure to the elements and which is convenient to the permanent or semipermanent installation of the equipment. Instructions for unpacking the electrical cabinet are given in subparagraph *b* below. Instructions for unpacking the component units are given in subparagraph *c* below.

b. Step-by-step Instructions for Uncrating and Unpacking Electrical Equipment Cabinet CY-1119/U. (fig. 24)

(1) Place the crate containing the cabinet as near as possible to the operating position.
(2) Cut and fold back the metal straps.
(3) Remove the nails with a nail puller. Remove the top and two sides from the crate. Do not attempt to pry off the sides or top; the cabinet may become damaged.
(4) Cut and fold back the corrugated fiberboard cushion, the waterproof barrier, and the moistureproof-vaporproof barrier.
(5) Cut and fold back the metal straps from the cabinet.
(6) Remove the bags of desiccant and the fiberboard box which contains spare parts and accessories.

Note. The spare parts and accessories may be shipped with the spares and accessories of the component units of the radio receiving set.

(7) Lift the cabinet from the mounting base and out of the crate. Position the cabinet as specified in paragraph 18.

Note. It is not necessary to remove the mounting base from the bottom of the skidded crate to remove the cabinet. When the equipment is repacked, however, the mounting base must be removed to install new waterproof barrier, moisture-vaporproof barrier, and the corrugated fiberboard cushion.

(8) Inspect the cabinet for possible damage incurred during shipment.
(9) Check the contents of the packing case against the master packing slip.

Note. Electrical Equipment Cabinet CY-1119/U may be received in domestic packing cases. In this case the waterproof barrier is not used and the desiccant is not packed with the cabinet. Instructions for unpacking a domestic shipment are the same as those given in steps (1) through (9) above. Save the original packing cases for both export and domestic shipments. They can be used again when the equipment is repacked for storage or shipment.

c. Step-by-step Instructions for Uncrating and Unpacking Component Units of Radio Receiving Set AN/FRR-33. (fig. 25)

(1) Place the packing cases containing the component units as near the operating location as possible.
(2) Cut and fold back the metal straps.
(3) Remove the nails with a nail puller. Remove the top and one side of the wooden shipping case. Do not attempt to pry off side and top, as this may damage the equipment.
(4) Remove excelsior covering the paper-wrapped sealed carton inside the crate and take out the carton.
(5) Remove the paper covering from the carton, open the outer corrugated fiberboard carton and withdraw the inner carton inclosed in the moisture-vaporproof barrier.
(6) Slit open the seams of the moisture-vaporproof barrier and remove the inner corrugated fiberboard carton.
(7) Open the inner carton and remove the wooden spacers from the inner carton. The carton containing the spares and accessories will not contain wooden spacers.
(8) Remove the bags of silica gel, the instruction books and the package containing cables from space at rear of unit.
(9) Withdraw paper-wrapped unit from the inner carton, place it on a workbench or near its final location, and remove the paper wrapping.

Note. Save the original packing cases and containers for both export and domestic shipments. They can be used again when the equipment is repacked for storage or shipment.

d. Checking.

(1) Check the contents of each crate against the master packing slip.
(2) Check the front panel of each unit for damage to the controls or meters.
(3) Operate the control knobs; examine for looseness. Rough operation or binding indicates a damaged control.
(4) Remove the top and bottom dust covers of each unit and inspect for loose tube shields or broken tubes.
(5) Inspect for broken or bent connectors on the rear panels.
(6) Check the contents of the box containing the running spares for missing or damaged parts.

20. Installation of Components of Radio Receiving Set AN/FRR–33

When all components have been uncrated and all packing removed, set Electrical Equipment Cabinet CY-1119/U on a level section of floor area that will permit the rear of the equipment to be easily reached. Follow the instructions contained in the subparagraphs below in assembling the equipment.

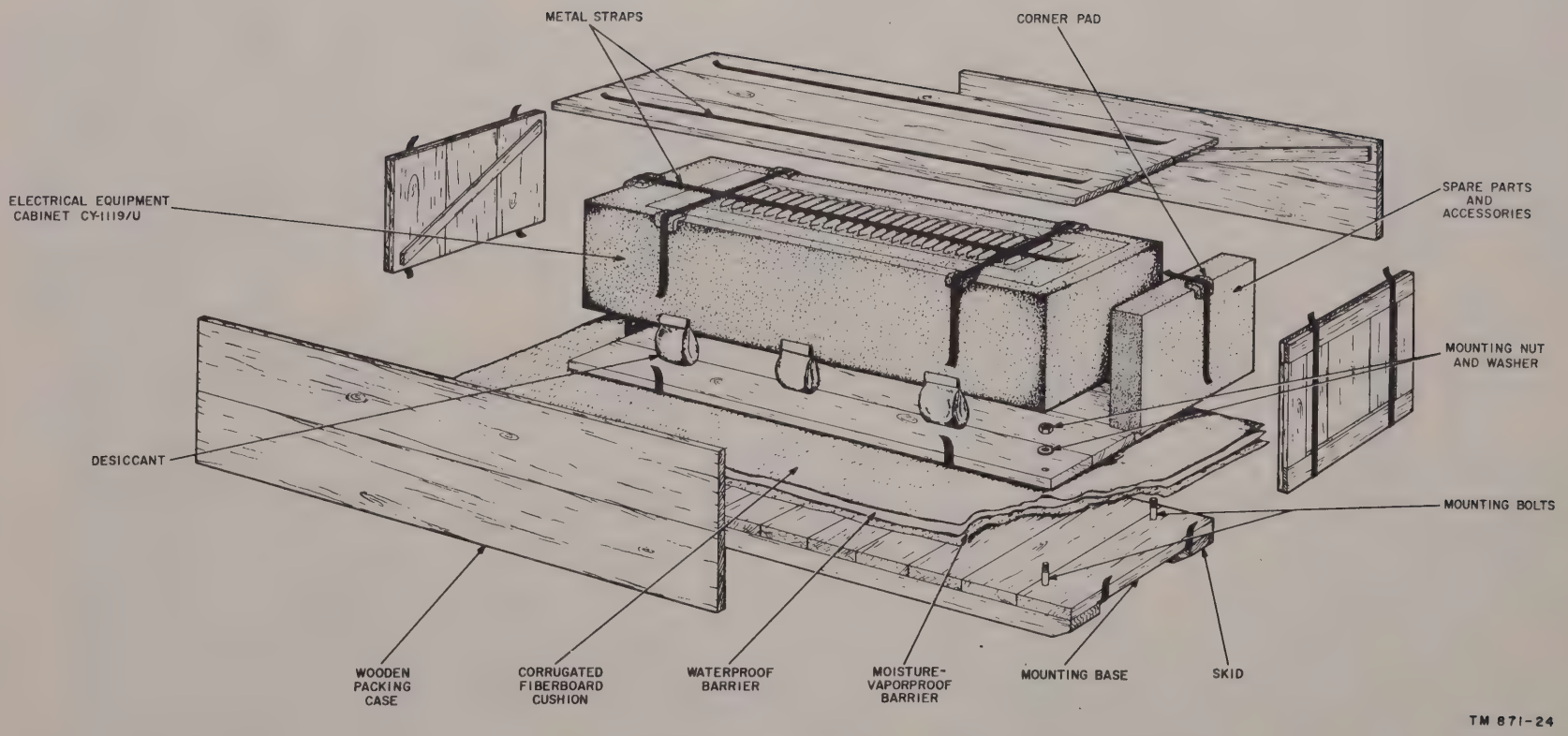


Figure 24. Electrical Equipment Cabinet CY-1119/U, packing and packaging.

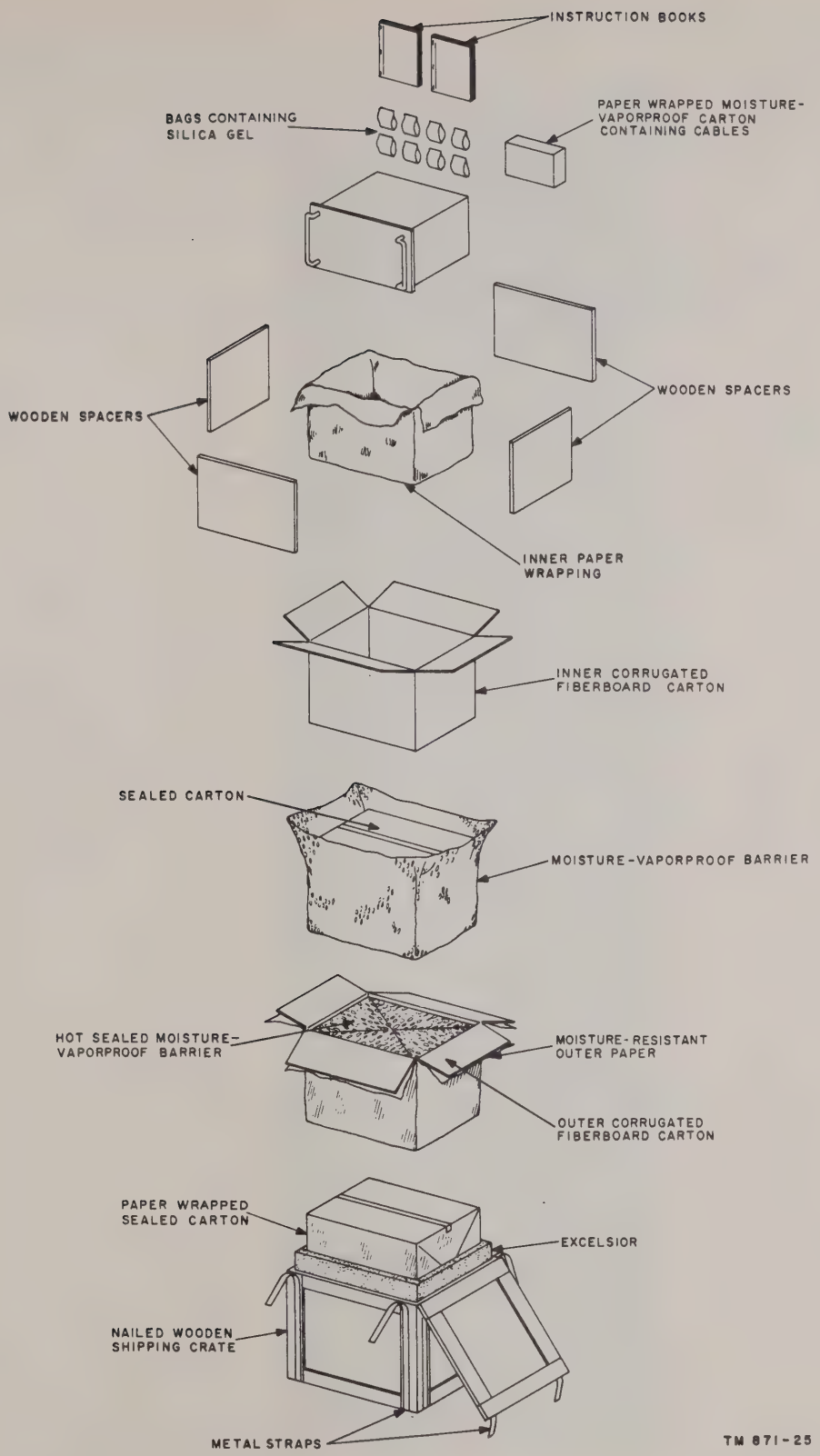


Figure 25. Radio Receiving Set AN/FRR-33, typical component packing and packaging.

a. Installation Kit. Remove all of the parts of the installation kit and check to see that all parts have been shipped. An itemized list of parts is shown in figures 26, 27, and 28. In the following discussion (and in paragraph 21) the lettered references refer to call-outs in these two figures. Assemble the equipment in the following sequence.

(1) Using items J, K, L, M, and N, mount the 12 shelf angles as illustrated in figure 26. Note the position of the two different washers; the flat washer (L) is located immediately beneath the head of the cap screw (K), while the lock washer (M) is placed against the cabinet just beneath the nut (N).

Note. To position the component units properly, the brackets may have to be readjusted.

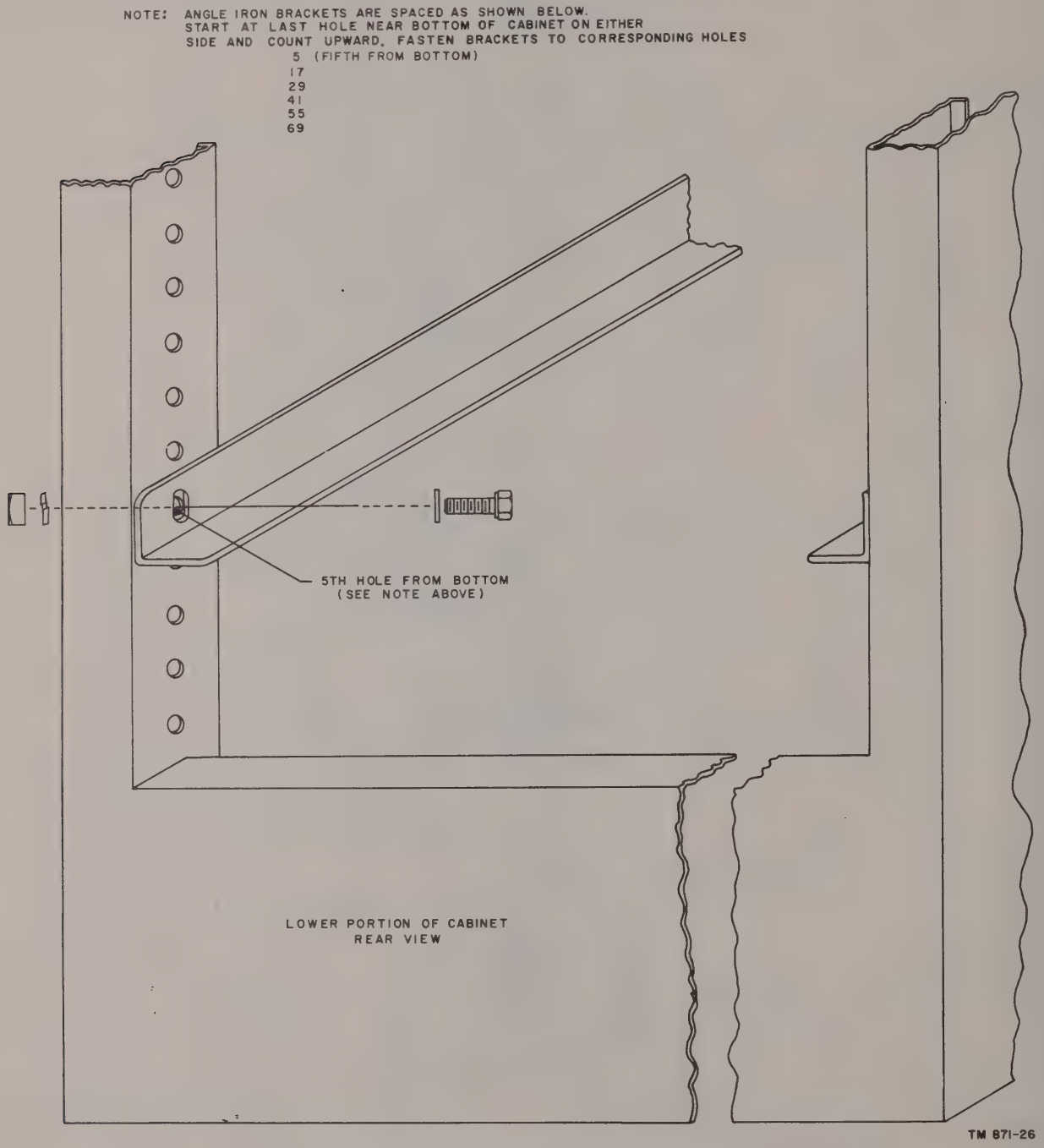


Figure 26. Installation diagram, shelf placement.

ITEM	QTY	DESCRIPTION
A	1	NAMEPLATE
B	4	SCREW: 2-56 NC-2 (1/4 IN.)
C	4	WASHER: SPLIT LOCK NO. 2
D	56	SCREW: 12-24 NC-2 (5/8 IN.) PHILLIPS OVAL HEAD
E	56	WASHER: NO. 12 CUP
F	56	WASHER
G	4	PANEL: BLANK 1 3/4 IN.
H	1	PANEL: BLANK 5 1/4 IN.

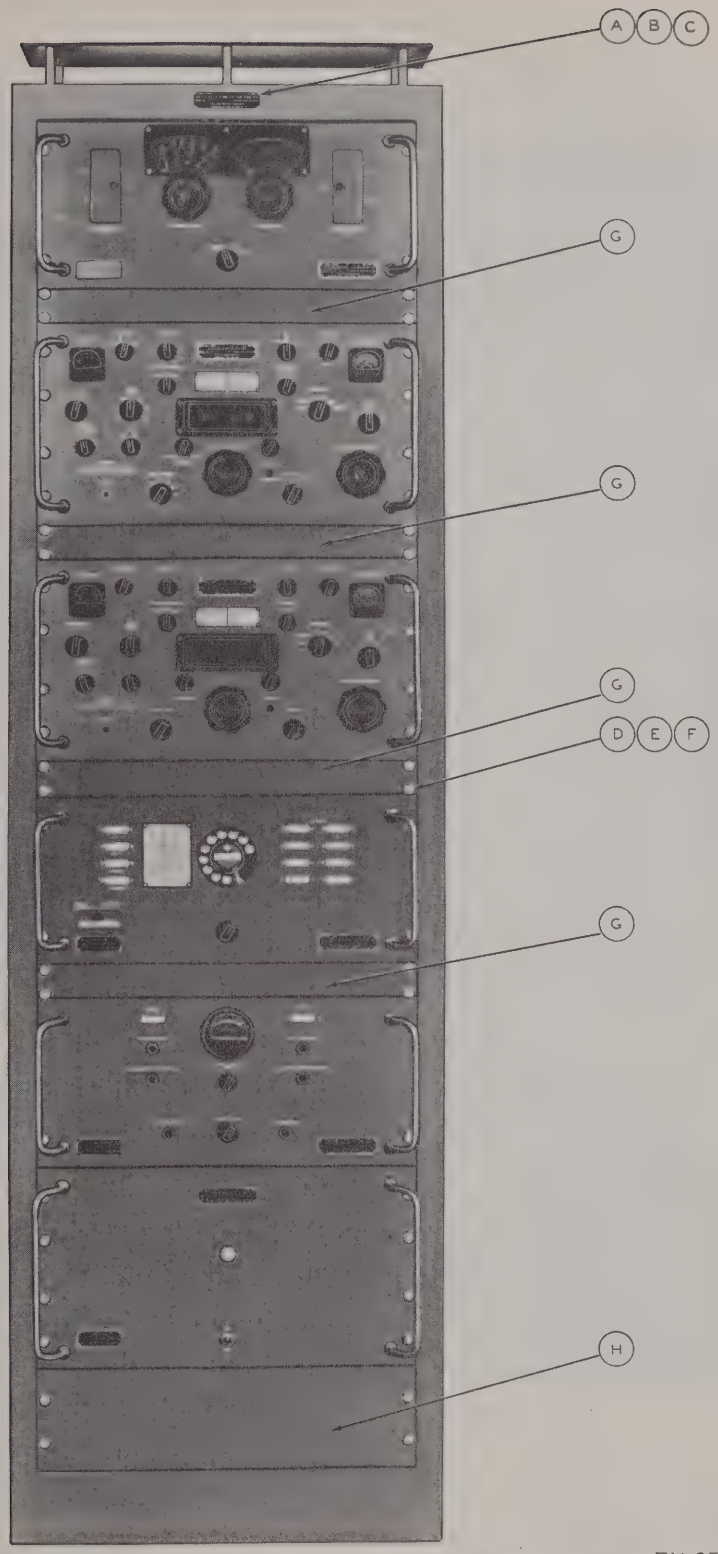
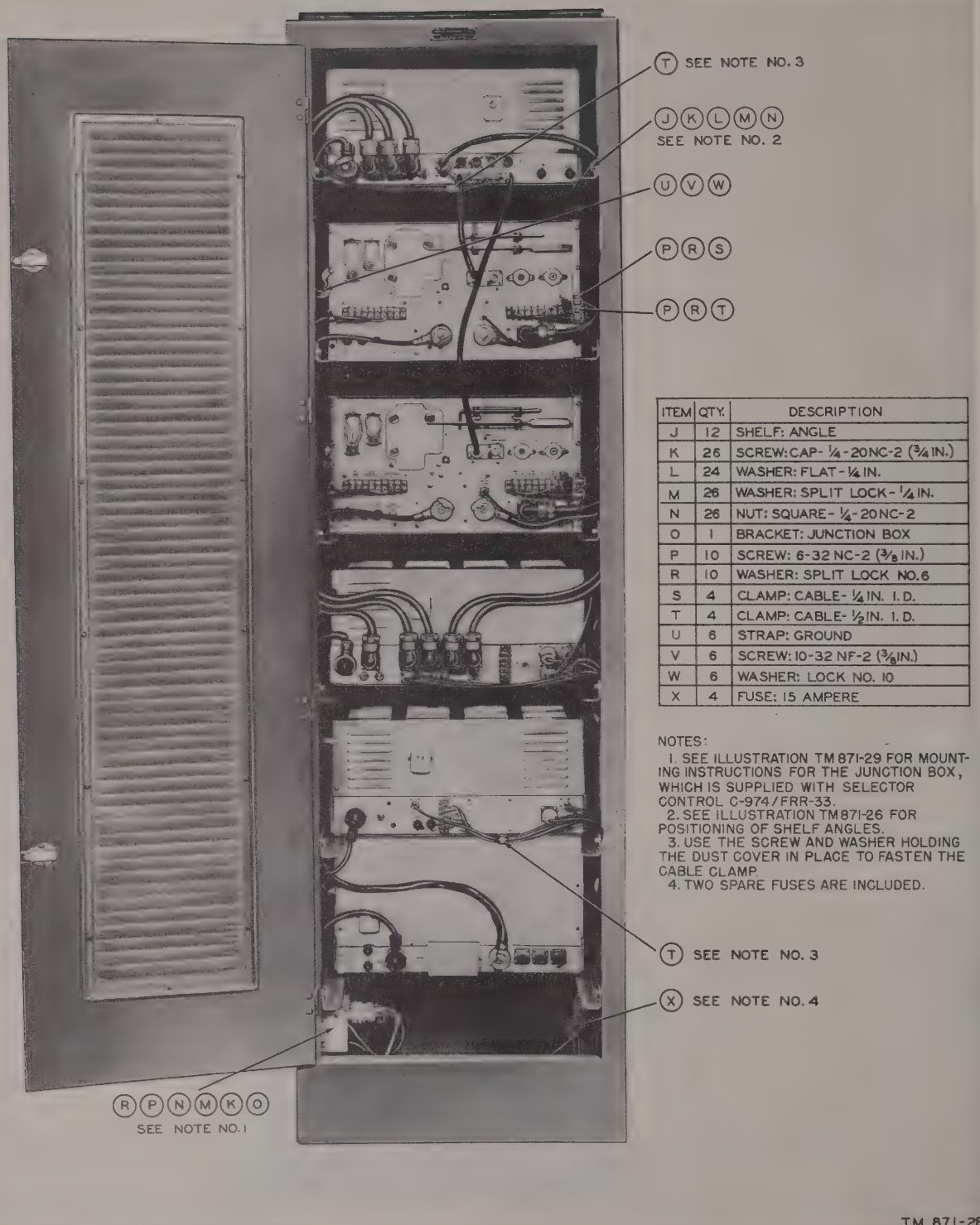


Figure 27. Installation diagram, front view.



ITEM	QTY.	DESCRIPTION
J	12	SHELF: ANGLE
K	26	SCREW: CAP- ¼-20NC-2 (¾ IN.)
L	24	WASHER: FLAT- ¼ IN.
M	26	WASHER: SPLIT LOCK- ¼ IN.
N	26	NUT: SQUARE- ¼-20NC-2
O	1	BRACKET: JUNCTION BOX
P	10	SCREW: 6-32 NC-2 (⅜ IN.)
R	10	WASHER: SPLIT LOCK NO.6
S	4	CLAMP: CABLE- ¼ IN. I. D.
T	4	CLAMP: CABLE- ½ IN. I. D.
U	6	STRAP: GROUND
V	6	SCREW: 10-32 NF-2 (⅜ IN.)
W	6	WASHER: LOCK NO. 10
X	4	FUSE: 15 AMPERE

NOTES:
1. SEE ILLUSTRATION TM 871-29 FOR MOUNTING INSTRUCTIONS FOR THE JUNCTION BOX, WHICH IS SUPPLIED WITH SELECTOR CONTROL C-974/FRR-33.
2. SEE ILLUSTRATION TM 871-26 FOR POSITIONING OF SHELF ANGLES.
3. USE THE SCREW AND WASHER HOLDING THE DUST COVER IN PLACE TO FASTEN THE CABLE CLAMP.
4. TWO SPARE FUSES ARE INCLUDED.

TM 871-28

Figure 28. Installation diagram, rear view.

(2) Mount the junction box assembly (supplied as part of the installation kit) on the junction box bracket (O), using ten each of screw P and split lock washer R. Then mount the assembled junction box on the bracket supplied with the installation kit, using the remaining two screws, washers, and nuts called out as items K, M, and N. This assembly procedure is shown in figure 29.

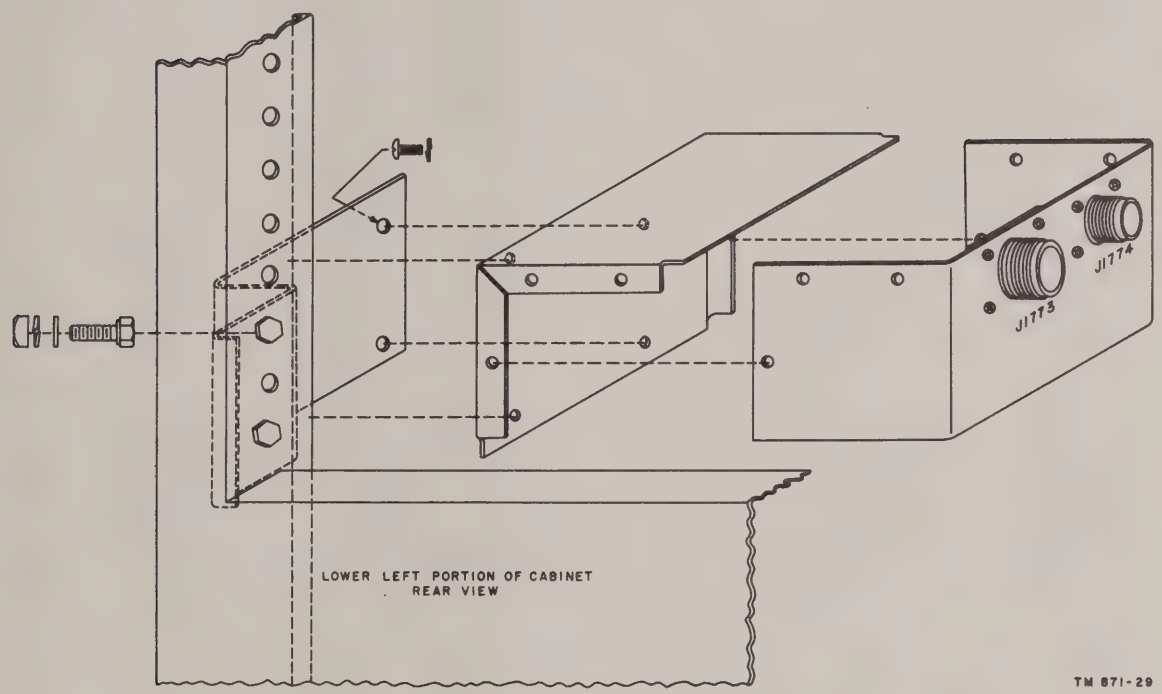


Figure 29. Junction box, mounting diagram.

b. Antenna Coupler CU-286/FRR-33. Before installing the antenna coupler, check all tubes to see that they are firmly seated in their correct sockets (fig. 30). Install the antenna coupler on the top pair of shelf angles. Use four screws (D), cup washers (E), and flat washers (F) to mount the antenna coupler to the cabinet. Remove FUSES F1301 2.0A and F1302 .375A from the rear panel. See that they are of the proper rating.

Caution: To avoid damage to the antenna coupler, do not use a fuse rated above the specified value.

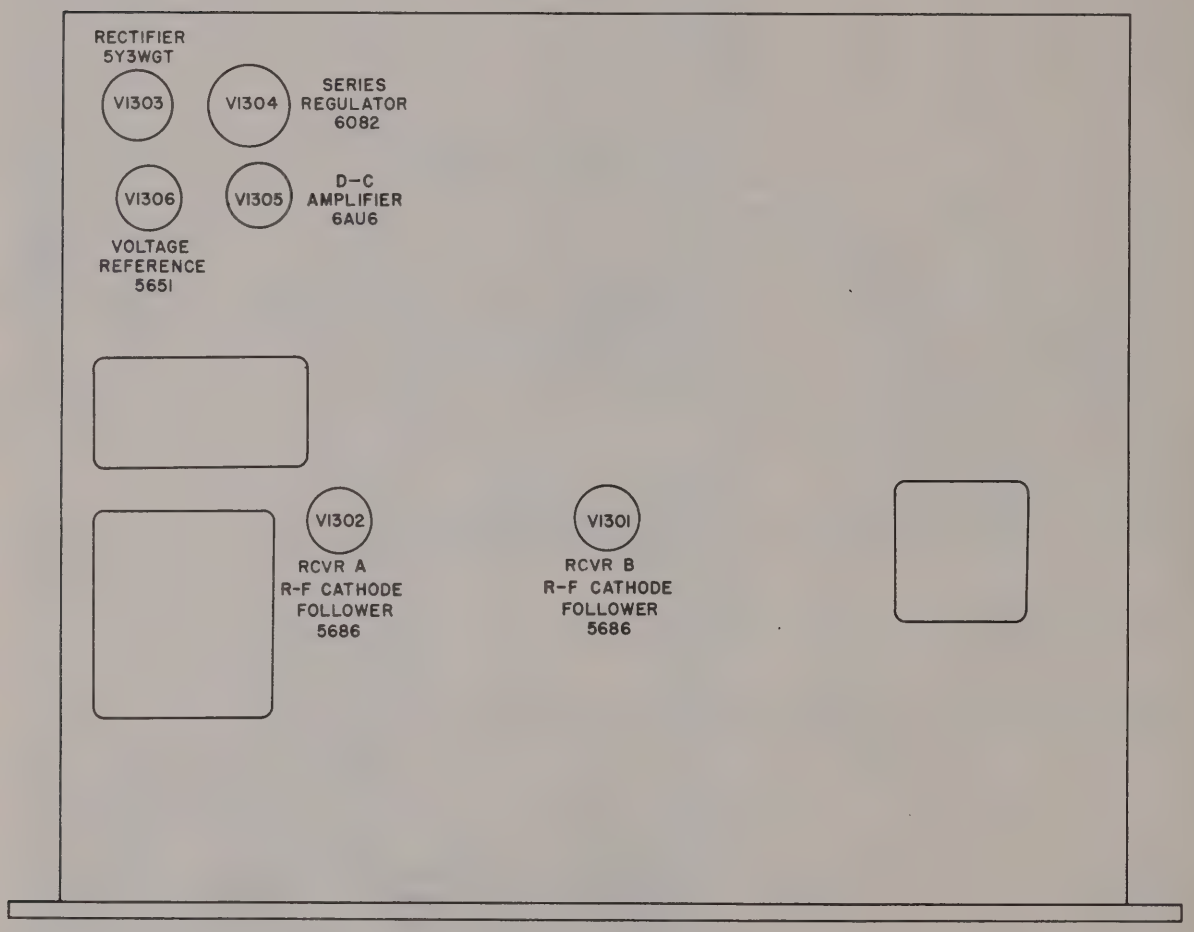


Figure 30. Antenna Coupler CU-286/FRR-33, tube locations.

c. Radio Receiver R-391/URR. Before installing receivers, check all tubes to see that they are firmly seated in their correct sockets (figs. 31 and 32). Install the two receivers on the next two pair of shelf angles. Throughout the remainder of the instruction book the receiver installed on the second pair of shelf angles will be referred to as receiver B. In the same manner the lower receiver will be called receiver A. Use eight screws (D), cup washers (E), and flat washers (F) to mount each receiver. Remove FUSES 101 AC 3A and F102 B+ 3/8A from the rear panel. See that they are of the proper rating.

Caution: To avoid damage to the receiver, do not use a fuse rated above the specified value.

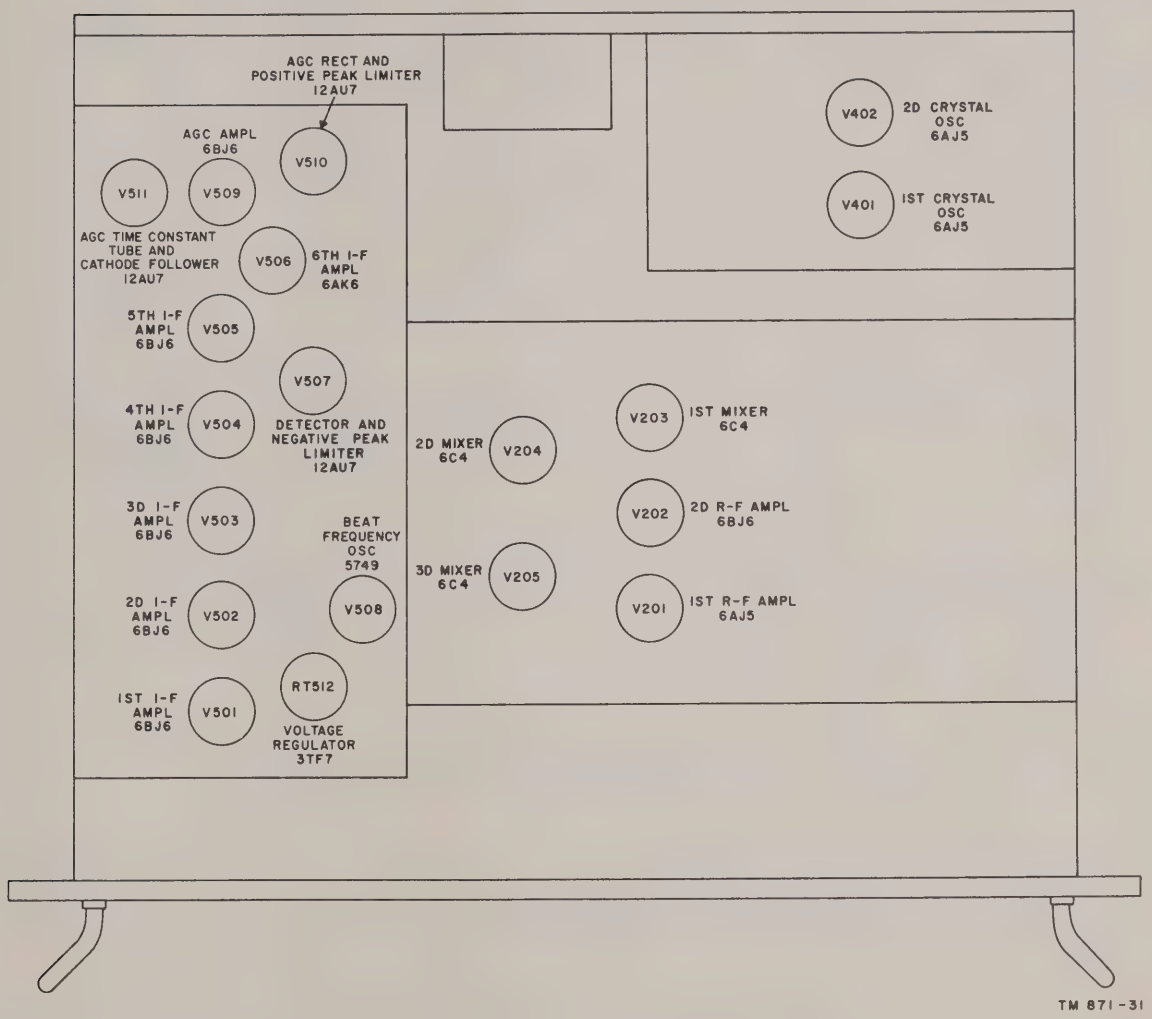


Figure 31. Radio Receiver R-391/URR, tube locations, top view.

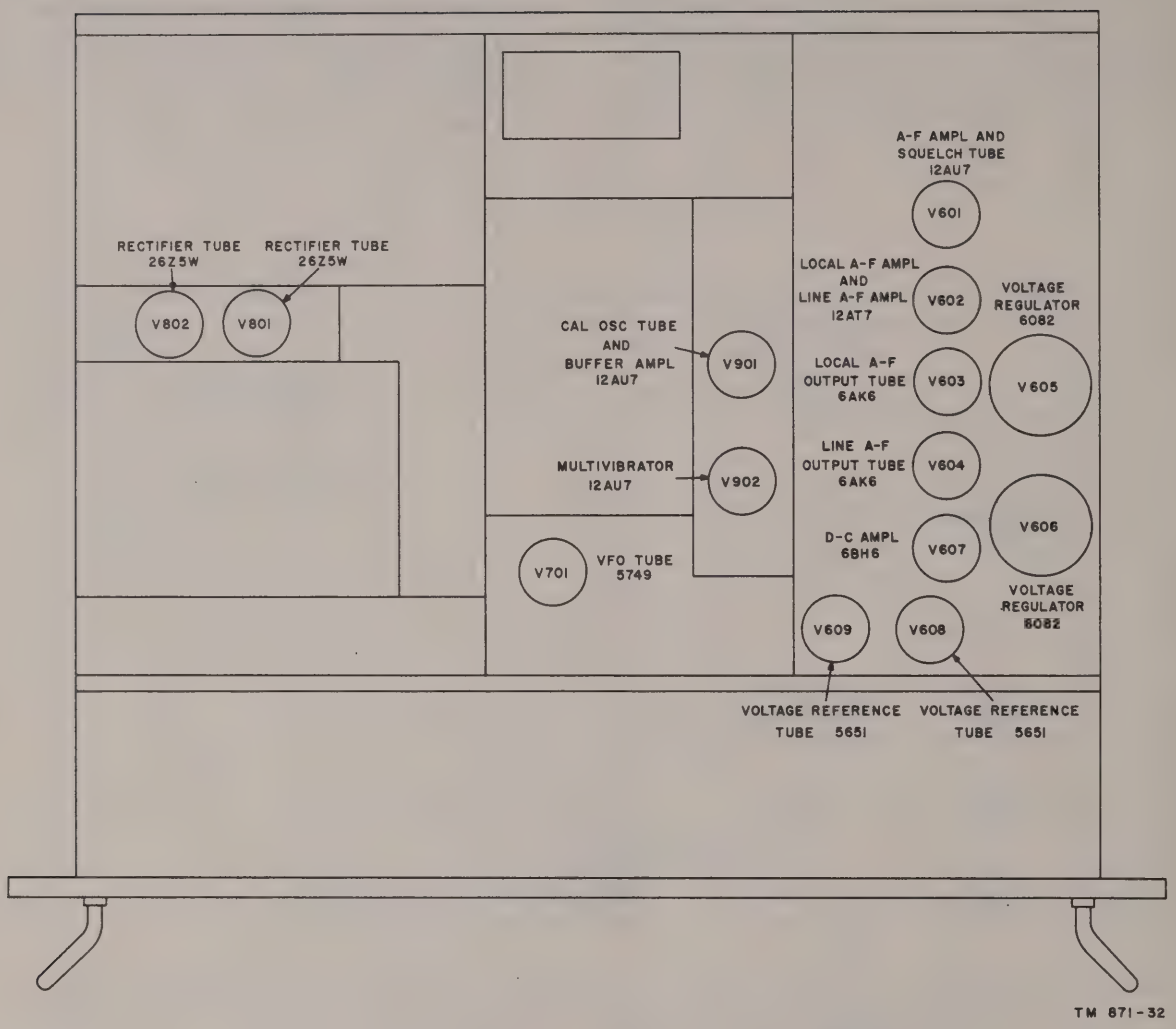


Figure 32. Radio Receiver R-391/URR, tube locations, bottom view.

d. Selector Control C-974/FRR-33. Before installing the selector control check all tubes for proper mounting and positioning (fig. 33). Install the selector control on the pair of shelf angles below receiver A. Use four each of items D, E, and F to mount the selector control to the cabinet. Remove FUSES F1401 2 AMP and F1402 .25 AMP from the rear panel. See that they are of the proper rating.

Caution: To avoid damage to the selector control, do not use a fuse rated above the specified value.

e. Receiver Control C-975/URR. Before installing the receiver control, check all tubes for firm seating in correct sockets (fig. 34). Install the receiver control just below the selector control. Use four each of items D, E, and F to mount the receiver control. Remove FUSES F1501 3 AMP and F1502 .375 AMP from the rear panel. See that they are of the proper rating.

Caution: To avoid damage to the receiver control, do not use a fuse rated above the specified value.

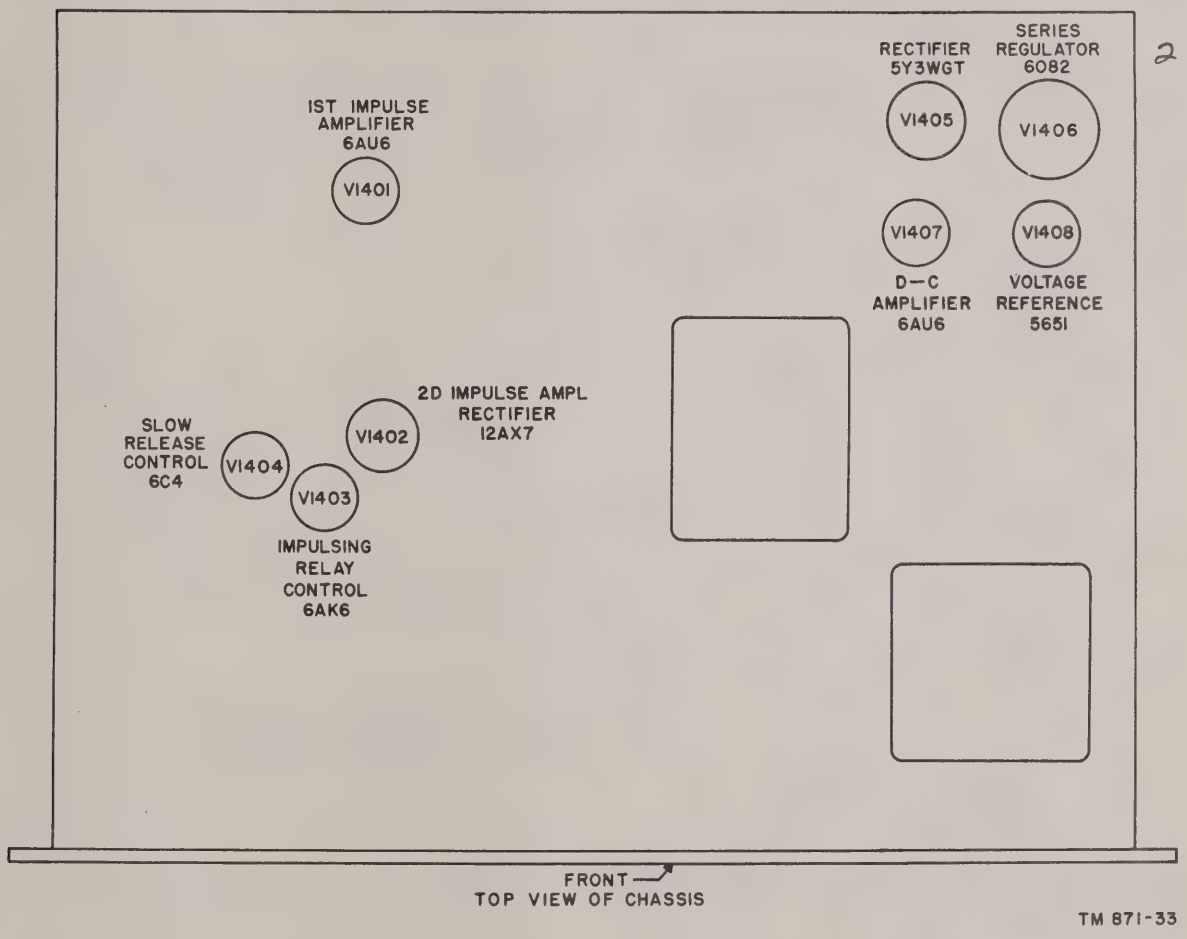


Figure 33. Selector Control C-974/FRR-33, tube locations.

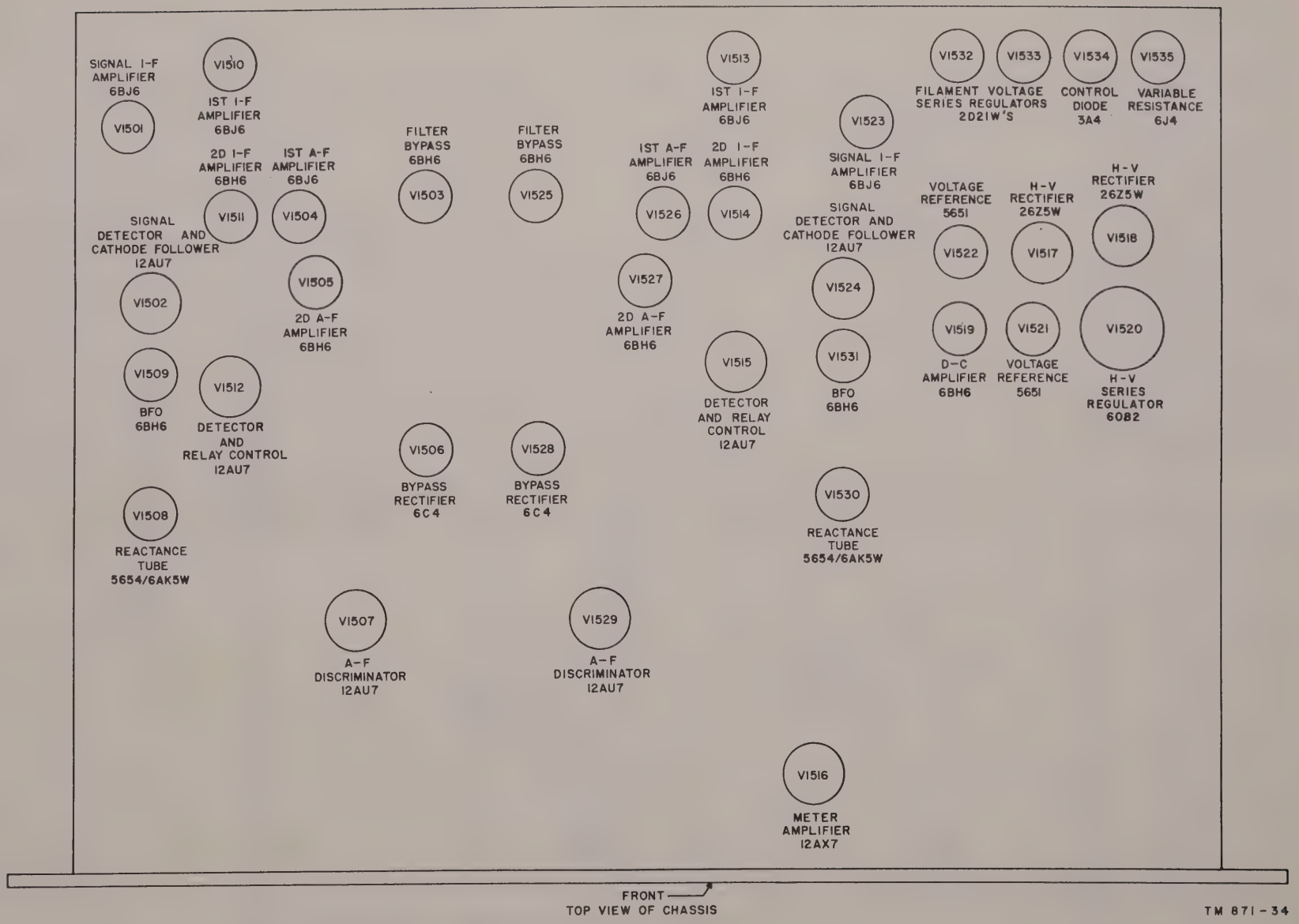


Figure 34. Receiver Control C-975/URR, tube locations.

f. Power Supply PP-629/URR. Install the power supply on the bottom pair of shelf angles, using eight each of items D, E, and F to mount the unit to the cabinet. Remove FUSES F1101 10 AMP and F1102 10 AMP from the rear panel. See that they are of the proper rating.

Caution: To avoid damage to the power supply, do not use a fuse rated above that specified.

g. Blank Panels. Mount the blank panels, items G and H, in the positions indicated in figure 27. Use items D, E, and F to mount the panels.

h. Grounding Straps (fig. 28). Connect a ground strap (U) from each of the units to the ground bus of the cabinet. Mount one end of the ground strap under a screw on the rear of each unit and use screw V and lock washer W to connect the other end to the ground bus.

i. Nameplate. Attach the nameplate (A) to the cabinet as indicated in figure 27, using items B and C to mount the nameplate.

j. Remote Switching Control C-973/FRR-33. The remote switching control is installed at the remote control location. The unit is a self-contained unit and has no separate installation parts. Remove FUSES F1201 1.0A and F1202 .25A from the rear panel. See that they are of the proper value.

Caution: To avoid damage to the remote switching control, do not use a fuse rated above that specified.

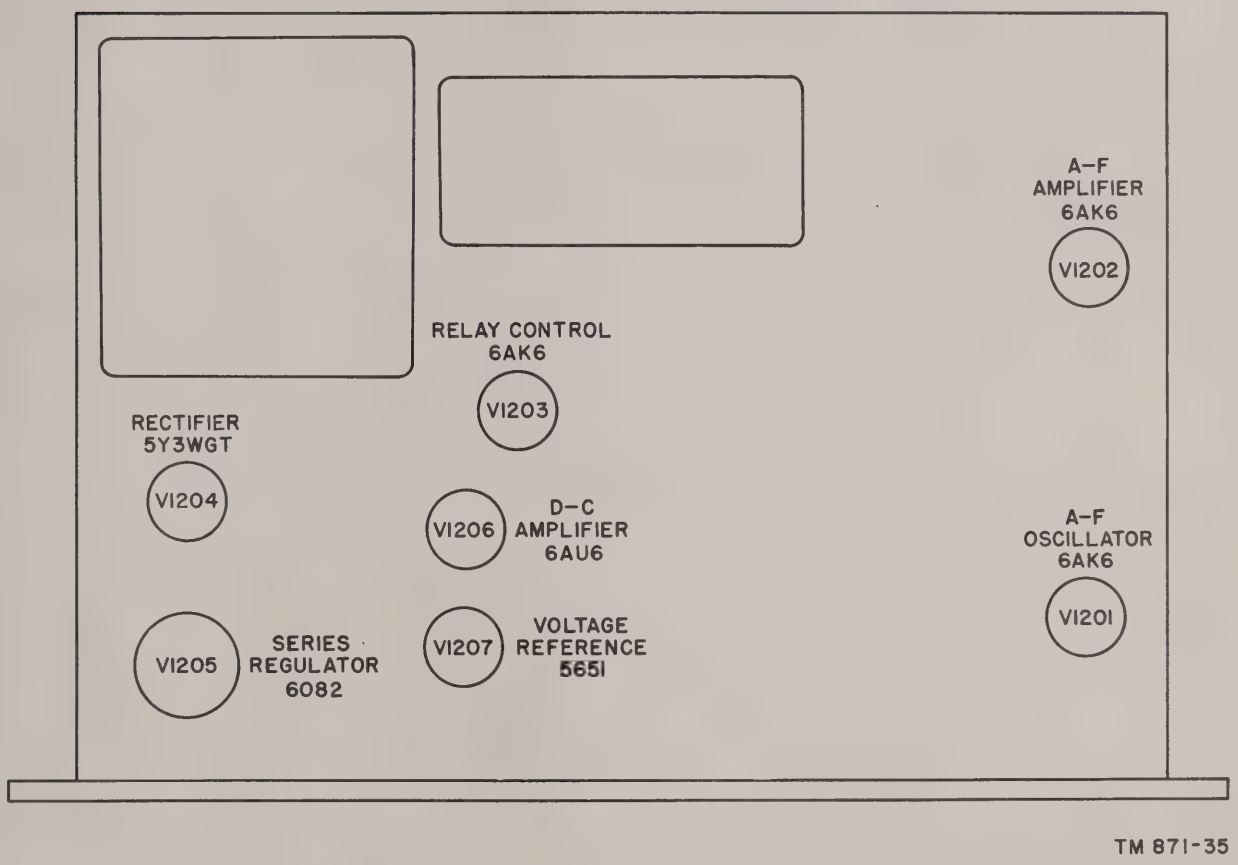


Figure 35. Remote Switching Control C-973/FRR-33, tube locations.

21. Connections

a. Interconnections.

(1) After installing the units as described in paragraph 20, connect the cables to the units as shown in the cording diagram (fig. 36). The chart below lists the connections within Radio Receiving Set AN/FRR-33. Items P, R, T, and S are used in securing cables to the units. The cable clamp used with the receiver control (see figure 28 for placement) is secured with a screw and lock washer that also hold the bottom dust cover in place.

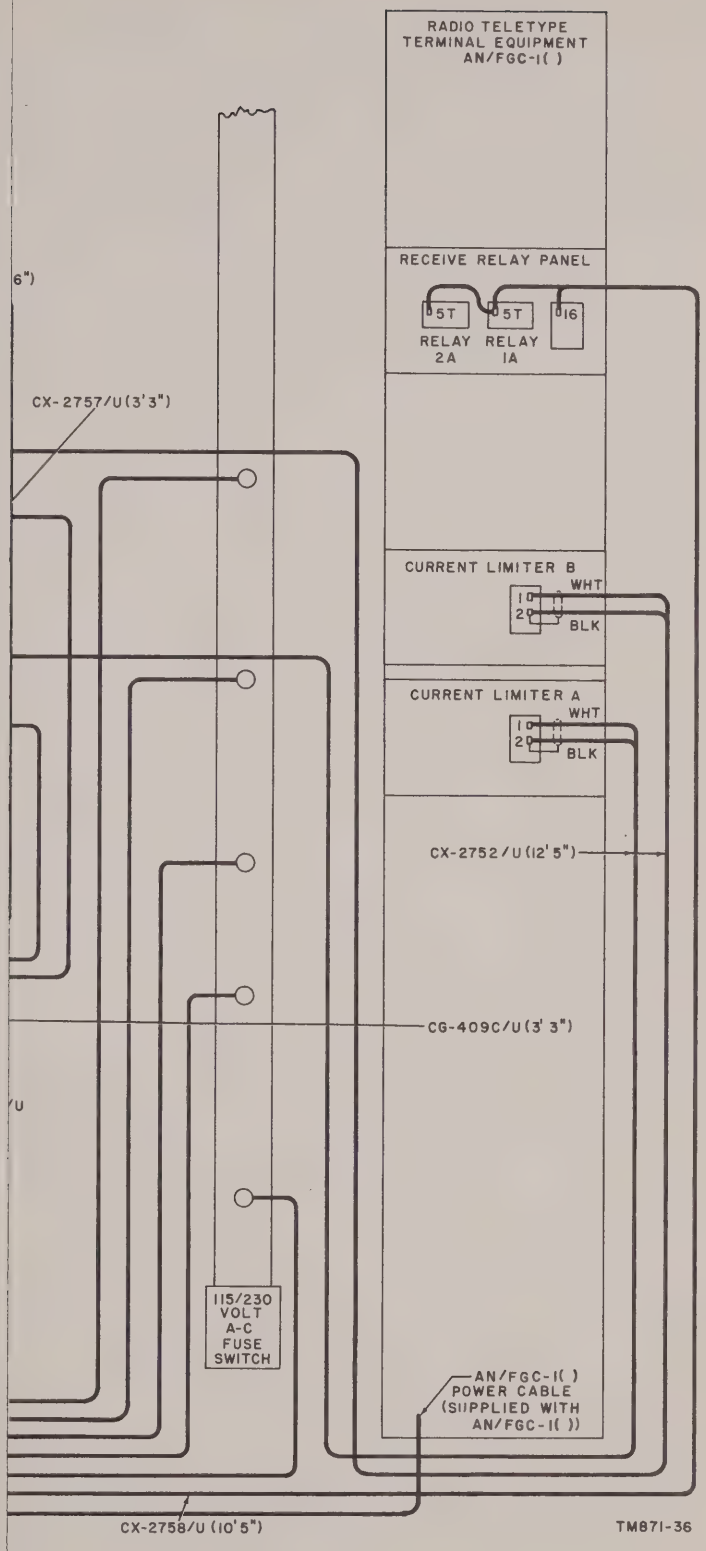
(2) Electrical Special Purpose Cable Assembly CX-2753/U is connected in the following manner:

(*a*) Connect the black lead of one end to TB-1501 of the receiver control, using the terminal labeled TO DIODE TRANSFORMER REC. A NO. 14. Connect the white lead to the terminal labeled TO DIODE LOAD REC. A NO. 15 and the shield to GROUND. Connect the other end to TB102 of receiver A, using terminal 14 for the black lead, terminal 15 for the white lead, and terminal 16 for the shield.

(*b*) Connect the second Electrical Special Purpose Cable Assembly CX-2753/U to the terminals on TB1501 labeled for receiver B and terminal board TB102 of receiver B, following the identical color coding used for receiver A.

b. Radioteletype Equipment Connections. Radio Receiving Set AN/FRR-33 normally is used with Radioteletype Terminal Equipment AN/FGC-1( ). Interconnections are shown in figure 36. Make the connections listed in subparagraph *b*(1) and (2); page 41.

Cable Assembly	Req. No.	From-	To-
RF Cable Assembly CG–1189/U (1′9″)	1	Antenna coupler (J1347)	Receiver B (J108)
RF Cable Assembly CG–1189/U (2′6″)	1	Antenna coupler (J1348)	Receiver A (J108)
Electrical Special Purpose Cable Assembly CX–2753/U	2	Antenna coupler (TB1301)	Receiver B (TB102)
		Antenna coupler (TB1301)	Receiver A (TB102)
Power Cable Assembly CX–1358/U	5	Antenna coupler (J1342)	Ac power strip
		Receiver B (J104)	Ac power strip
		Receiver A (J104)	Ac power strip
		Receiver control (J1570)	Ac power strip
		Power Supply PP–629/URR (J1131)	Ac power strip
Electrical Power Cable Assembly CX–2755/U	1	Selector control (J1458)	Junction box (J1773)
Electrical Power Cable Assembly CX–2758/U	1	Junction box (J1774)	Radioteletype equipment (par. 22)
Electrical Special Purpose Cable Assembly CX–2757/U	2	Selector control (J1460)	Receiver A (TB101)
		Selector control (J1461)	Receiver B (TB101)
Electrical Power Cable Assembly CX–2756/U	1	Selector control (J1459)	Antenna coupler (J1343)
Electrical Special Purpose Cable Assembly CX–2754/U	5	Selector control (J1462)	Antenna coupler (J1346)
		Selector control (J1466)	Antenna coupler (J1345)
		Selector control (J1465)	Antenna coupler (J1351)
		Selector control (J1463)	Receiver B (J121)
		Selector control (J1464)	Receiver A (J121)
Electrical Power Cable Assembly CX–2751/U	1	Selector control (J1453)	Power Supply PP–629/URR (J1132)
Electrical Power Cable Assembly CX–2759/U	1	Selector control (J1454)	Receiver control (J1571)
Electrical Special Purpose Cable Assembly CX–2753/U	2	Receiver control (TB1501)	Receiver B (TB101)
		Receiver control (TB1501)	Receiver A (TB101)
Electrical Special Purpose Cable Assembly CX–2752/U	2	Receiver B (TB101)	Radioteletype equipment (see *b* below)
		Receiver A (TB101)	Radioteletype equipment (see *b* below)
Cord CG–409C/U	2	Receiver control (J1567)	Receiver A (J106)
		Receiver control (J1568)	Receiver B (J106)
Special Purpose Cable Assembly CX–2083/U	2	Selector control (J1455)	Receiver B (J105)
		Selector control (J1456)	Receiver A (J105)



ing Set AN/FRR-33, cording diagram.

21. Connections

a. Interconnections.

(1) After installing the units as described in paragraph 20, connect the cables to the units as shown in the cording diagram (fig. 36). The chart below lists the connections within Radio Receiving Set AN/FRR-33. Items P, R, T, and S are used in securing cables to the units. The cable clamp used with the receiver control (see figure 28 for placement) is secured with a screw and lock washer that also hold the bottom dust cover in place.

(2) Electrical Special Purpose Cable Assembly CX-2753/U is connected in the following manner:

(*a*) Connect the black lead of one end to TB-1501 of the receiver control, using the terminal labeled TO DIODE TRANSFORMER REC. A NO. 14. Connect the white lead to the terminal labeled TO DIODE LOAD REC. A NO. 15 and the shield to GROUND. Connect the other end to TB102 of receiver A, using terminal 14 for the black lead, terminal 15 for the white lead, and terminal 16 for the shield.

(*b*) Connect the second Electrical Special Purpose Cable Assembly CX-2753/U to the terminals on TB1501 labeled for receiver B and terminal board TB102 of receiver B, following the identical color coding used for receiver A.

b. Radioteletype Equipment Connections. Radio Receiving Set AN/FRR-33 normally is used with Radioteletype Terminal Equipment AN/FGC-1( ). Interconnections are shown in figure 36. Make the connections listed in subparagraph *b*(1) and (2); page 41.

Cable Assembly	Req. No.	From-	To-
RF Cable Assembly CG–1189/U (1′9″)	1	Antenna coupler (J1347)	Receiver B (J108)
RF Cable Assembly CG–1189/U (2′6″)	1	Antenna coupler (J1348)	Receiver A (J108)
Electrical Special Purpose Cable Assembly CX–2753/U	2	Antenna coupler (TB1301)	Receiver B (TB102)
		Antenna coupler (TB1301)	Receiver A (TB102)
Power Cable Assembly CX–1358/U	5	Antenna coupler (J1342)	Ac power strip
		Receiver B (J104)	Ac power strip
		Receiver A (J104)	Ac power strip
		Receiver control (J1570)	Ac power strip
		Power Supply PP–629/URR (J1131)	Ac power strip
Electrical Power Cable Assembly CX–2755/U	1	Selector control (J1458)	Junction box (J1773)
Electrical Power Cable Assembly CX–2758/U	1	Junction box (J1774)	Radioteletype equipment (par. 22)
Electrical Special Purpose Cable Assembly CX–2757/U	2	Selector control (J1460)	Receiver A (TB101)
		Selector control (J1461)	Receiver B (TB101)
Electrical Power Cable Assembly CX–2756/U	1	Selector control (J1459)	Antenna coupler (J1343)
Electrical Special Purpose Cable Assembly CX–2754/U	5	Selector control (J1462)	Antenna coupler (J1346)
		Selector control (J1466)	Antenna coupler (J1345)
		Selector control (J1465)	Antenna coupler (J1351)
		Selector control (J1463)	Receiver B (J121)
		Selector control (J1464)	Receiver A (J121)
Electrical Power Cable Assembly CX–2751/U	1	Selector control (J1453)	Power Supply PP–629/URR (J1132)
Electrical Power Cable Assembly CX–2759/U	1	Selector control (J1454)	Receiver control (J1571)
Electrical Special Purpose Cable Assembly CX–2753/U	2	Receiver control (TB1501)	Receiver B (TB101)
		Receiver control (TB1501)	Receiver A (TB101)
Electrical Special Purpose Cable Assembly CX–2752/U	2	Receiver B (TB101)	Radioteletype equipment (see *b* below)
		Receiver A (TB101)	Radioteletype equipment (see *b* below)
Cord CG–409C/U	2	Receiver control (J1567)	Receiver A (J106)
		Receiver control (J1568)	Receiver B (J106)
Special Purpose Cable Assembly CX–2083/U	2	Selector control (J1455)	Receiver B (J105)
		Selector control (J1456)	Receiver A (J105)

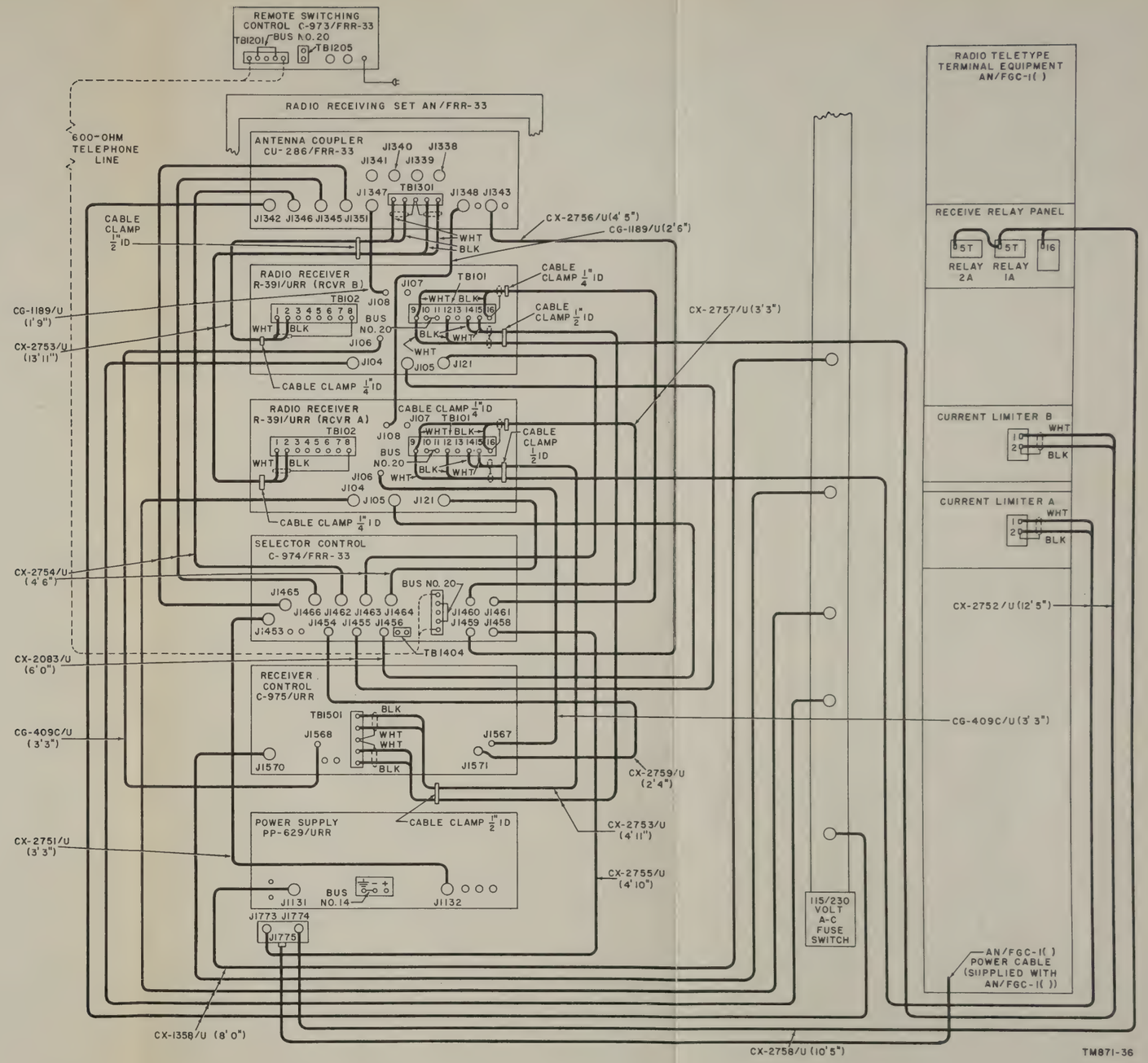


Figure 36. Radio Receiving Set AN/FRR-33, cording diagram.

(1) Connect the white lead of Electrical Special Purpose Cable Assembly CX-2752/U to terminal 10 of TB101, receiver B, using the end of the cable with spade lugs. Connect the black lead to terminal 13 of TB101 and ground the shield to terminal 16. Solder the tinned white lead of the other end to terminal 1 of terminal block A in Current Limiter B, located in the radioteletype terminal equipment. Solder the tinned black lead and the shield to terminal 2 of terminal block A, Current Limiter B.

(2) Connect the second Electrical Special Purpose Cable Assembly CX-2752/U to the corresponding terminals of receiver A and Current Limiter A.

c. Antenna Connections. Radio Receiving Set AN/FRR-33 is normally used with doublet or rhombic antennas. For information on antenna suitable for use with this equipment, refer to TM 11-666, Antenna and Radio Propagation. Connect the transmission lines from the various antennas to the following receptacles: Channel A antennas to CHAN. A ANT. 1 receptacle J1338 (fig. 39) and CHAN. A ANT. 2 receptacle J1339 (fig. 39); channel B antennas to CHAN. B ANT. 1 receptacle J1340 (fig. 39) and CHAN. B ANT. 2 receptacle J1341 (fig. 39). These receptacles furnish input to the antenna coupler through tuned antenna transformers and are used for both balanced antennas, such as a balanced doublet, and unbalanced, low-impedance transmission lines. Connect balanced coaxial cable such as Radio Frequency Cable RG-22/U from 50 to 175-ohm balanced antennas, to J1339 through J1341 with Plug Connector UG-421/U, or, when Cable RG-86/U transmission line is used, use Plug Connector UG-969/U. Right angle adapters are furnished with the equipment for connecting unbalanced coaxial cable to the balanced input receptacles. Adapter Connector UG-971/U adapts unbalanced coaxial lead-in terminated in Plug Connector UG-573/U to the antenna receptacles. If the coaxial cable is terminated in Plug PL-259, Adapter Connector UG-970/U must be used. Five each of Plug Connector UG-573/U and Adapter Connector UG-971/U are furnished for use with Radio Receiving Set AN/FRR-33.

d. Ac Power Connections. Power from the main ac source is connected to an ac switch located near the bottom of the cabinet. Two 15-ampere fuses are located in the switch box (see figure 28, item X). Connect the two ac input leads to the terminals designated LINE inside the ac switch.

Caution: Check to see that 115/230 VAC switches on all the units are in the proper position for operation of the units from the available power source. The switch on the receiver power supplies is reached easily when the dust cover is removed from the bottom of the receivers. The switch on the receiver control is reached by removing the top dust cover.

e. Removal of Receiver Jumpers. Radio Receiver R-391/URR is shipped with jumpers between terminals 1 and 2, 3 and 4, 11 and 12, and 14 and 15 of terminal boards TB101 and TB102. When used as part of Radio Receiving Set AN/FRR-33 the jumpers between terminals 1 and 2 and 14 and 15 must be removed.

f. Special Agc Operation. When the agc systems of the two receivers are to be tied together as described in paragraph 46, use the following procedure:

(1) Remove the jumper between terminals 3 and 4 of terminal board TB102 on each receiver.

(2) Connect the jumper between terminals 4 and 5 of terminal board TB102 on each receiver.

(3) Connect terminal 4 of terminal board TB102 of receiver B to the same terminal of receiver A. (No cable has been provided for this connection.)

22. Modification of Radioteletype Terminal Equipment AN/FGC–1( )

(fig. 37)

a. When used with Radio Receiving Set AN/FRR-33 it is desirable to discard the normal monitor condition of the terminal equipment and substitute a *disable* condition. This allows the radio receiving set to operate, but locks the terminal equipment to a steady mark position. The locked position is maintained until the *on* position is dialed. In order to accomplish this change, modify the circuits as follows:

(1) Connect a jumper from contact 5T of relay 1A to contact 5T of relay 2A on the receive relay panel in the Radioteletype Terminal Equipment AN/FGC-1( ). (Refer to figure 37 for contact arrangement).

(2) Connect one wire of the two-wire cable connected to receptacle J1774 (receptacle J1774 is

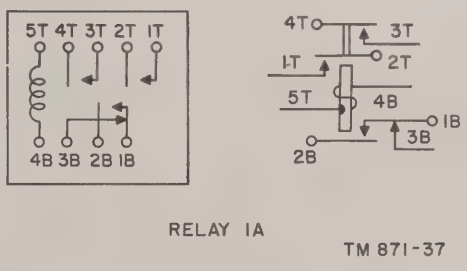


Figure 37. Radioteletype Terminal Equipment AN/FGC-1( ), receive relay panel, relay 1A, contact arrangement.

located on the junction box assembly in the radio receiving set (fig. 28)) to contact 5T of relay 1A.

(3) Connect the second wire of the two-wire cable to terminal 16 on the terminal block mounted on the receive relay panel.

(4) Place TST 1 and TST 2 keys in the open, or vertical position.

b. It is not absolutely necessary to jumper contacts 5T of relays 1A and 2A, but in order to use both keying inputs of the receiver relay panel it is considered useful to operate both relays 1A and 2A. (Refer to TM 11-356 for a schematic diagram of the receive relay panel). When 03 (disable) is dialed, relays 1A and 2A close. This puts *steady marking* current into the circuit to the automatic printer.

23. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 19 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes have been made, note the changes in this manual, preferably on the applicable schematic diagram.

Section II. CONTROL AND INSTRUMENTS

24. General

Haphazard operation and improper setting of controls may damage Radio Receiving Set AN/FRR-33. Therefore, the operator should familiarize himself with the controls and instruments and their functions before attempting to operate the equipment. The tuning and operation procedure for the components in the radio receiving set will be discussed in the next section of this manual.

25. Antenna Coupler CU–286/FRR–33 Controls

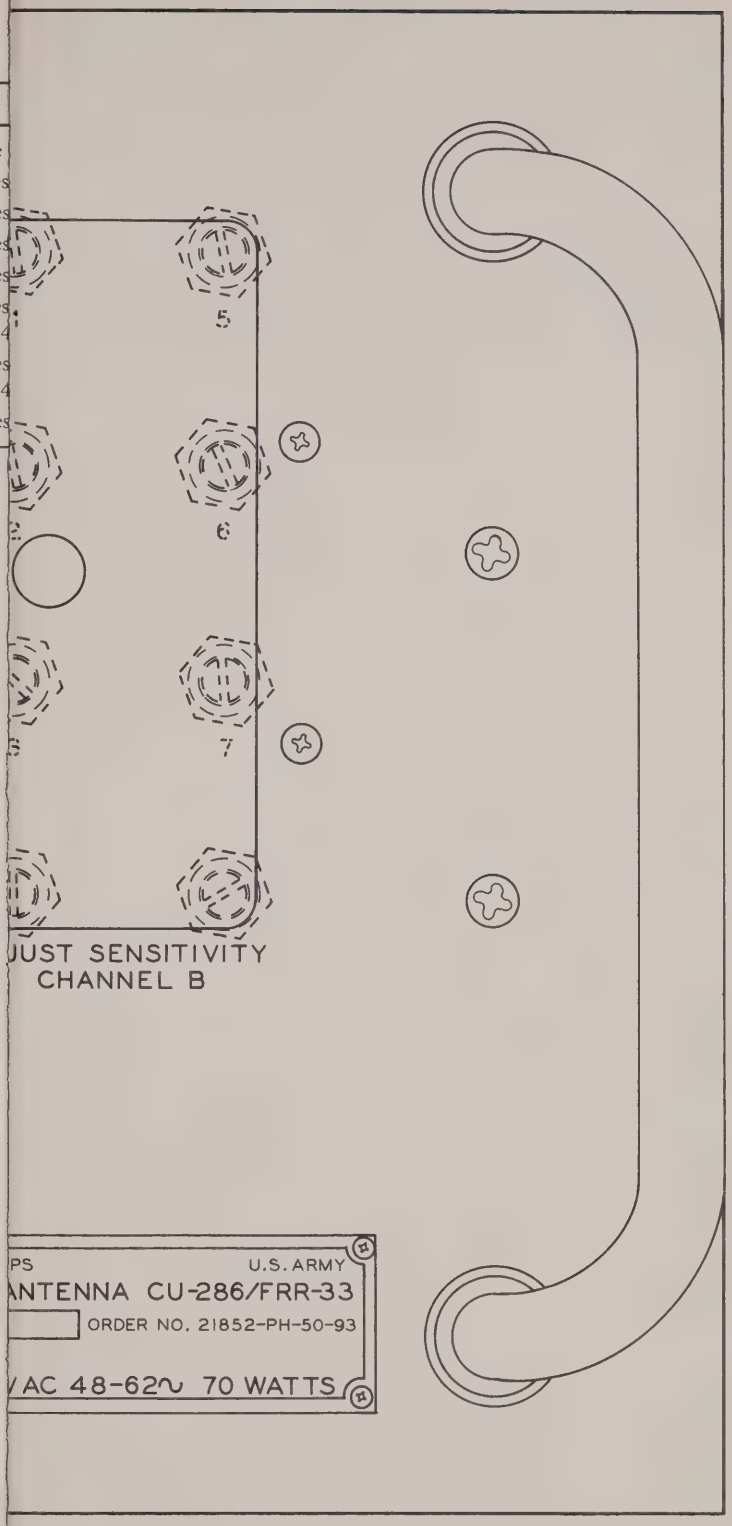
(figs. 38 and 39)

The following table lists the antenna coupler controls and indicates their function:

Control	Function
TUNING RANGE control	Part of Autotune system. Provides for selection of any one of six frequency ranges. Range dial mounted on common shaft. Provides for selection of appropriate input transformers.
ANTENNA TUNING control	Part of Autotune system. Provides for adjustment of transformer tuning slugs over tuning range of each transformer.
OFF—REMOTE—ANT 1—ANT 2 switch (S1303)	Energizes and de-energizes circuits, as follows: Position — Function OFF — De-energizes antenna coupler. REMOTE — Energizes plate power supply circuits. Provides for remote selection of antennas. Shifts control of receivers' rf sensitivity to antenna coupler. ANT 1 — Places antenna coupler in ANT 1 position. Rf sensitivity controlled in antenna coupler. ANT 2 — Operates relays K1301 and K1302 to place antenna coupler in ANT 2 position. Rf sensitivity controlled in antenna coupler.
ADJUST SENSITIVITY CHANNEL A controls	Eight potentiometers to adjust rf sensitivity of receiver A.
ADJUST SENSITIVITY CHANNEL B controls	Eight potentiometers to adjust rf sensitivity of receiver B.
ADJUST B+ control (R1314) (fig. 97)	Is a screwdriver adjustment to set output voltage of power supply to proper voltage.
115V/230V switch (S1302) (fig. 97)	In 115-volt position connects primary windings of transformers T1313 and T1314 in parallel; in 230-volt position connects windings in series.
B+ CHECK test point (J1344) (fig. 97)	Provides a test point to check the output B+ voltage and ripple of regulated high-voltage power supply.
FUSES F1301 2.0A and F1302.375A	Fuse F1301 is a line fuse. Fuse F1302 protects B+ circuits.
Terminal board TB1301	Provides connections to rf sensitivity control circuits.

25. Antenna Coupler CU–286/FRR–33

Control	
Receptacles J1338 through J1341	Provide
Receptacle J1348	Provides
Receptacle J1347	Provides
Receptacle J1343	Provides
Input power receptacle J1342	Provides
Receptacle J1345	Provides C–974
Receptacle J1346	Provides C–974
Receptacle J1351	Provides



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pler CU-286/FRR-33, front panel controls.

located on the junction box assembly in the radio receiving set (fig. 28)) to contact 5T of relay 1A.

(3) Connect the second wire of the two-wire cable to terminal 16 on the terminal block mounted on the receive relay panel.

(4) Place TST 1 and TST 2 keys in the open, or vertical position.

b. It is not absolutely necessary to jumper contacts 5T of relays 1A and 2A, but in order to use both keying inputs of the receiver relay panel it is considered useful to operate both relays 1A and 2A. (Refer to TM 11-356 for a schematic diagram of the receive relay panel). When 03 (disable) is dialed, relays 1A and 2A close. This puts *steady marking* current into the circuit to the automatic printer.

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a. Follow the instructions in paragraph 19 for uncrating, unpacking, and checking the equipment.

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Section II. CONTROL AND INSTRUMENTS

24. General

Haphazard operation and improper setting of controls may damage Radio Receiving Set AN/FRR-33. Therefore, the operator should familiarize himself with the controls and instruments and their functions before attempting to operate the equipment. The tuning and operation procedure for the components in the radio receiving set will be discussed in the next section of this manual.

25. Antenna Coupler CU–286/FRR–33 Controls

(figs. 38 and 39)

The following table lists the antenna coupler controls and indicates their function:

Control	Function
TUNING RANGE control	Part of Autotune system. Provides for selection of any one of six frequency ranges. Range dial mounted on common shaft. Provides for selection of appropriate input transformers.
ANTENNA TUNING control	Part of Autotune system. Provides for adjustment of transformer tuning slugs over tuning range of each transformer.
OFF—REMOTE—ANT 1—ANT 2 switch (S1303)	Energizes and de-energizes circuits, as follows: Position — Function OFF — De-energizes antenna coupler. REMOTE — Energizes plate power supply circuits. Provides for remote selection of antennas. Shifts control of receivers' rf sensitivity to antenna coupler. ANT 1 — Places antenna coupler in ANT 1 position. Rf sensitivity controlled in antenna coupler. ANT 2 — Operates relays K1301 and K1302 to place antenna coupler in ANT 2 position. Rf sensitivity controlled in antenna coupler.
ADJUST SENSITIVITY CHANNEL A controls	Eight potentiometers to adjust rf sensitivity of receiver A.
ADJUST SENSITIVITY CHANNEL B controls	Eight potentiometers to adjust rf sensitivity of receiver B.
ADJUST B+ control (R1314) (fig. 97)	Is a screwdriver adjustment to set output voltage of power supply to proper voltage.
115V/230V switch (S1302) (fig. 97)	In 115-volt position connects primary windings of transformers T1313 and T1314 in parallel; in 230-volt position connects windings in series.
B+ CHECK test point (J1344) (fig. 97)	Provides a test point to check the output B+ voltage and ripple of regulated high-voltage power supply.
FUSES F1301 2.0A and F1302 .375A	Fuse F1301 is a line fuse. Fuse F1302 protects B+ circuits.
Terminal board TB1301	Provides connections to rf sensitivity control circuits.

25. Antenna Coupler CU–286/FRR–33 Controls (cont)

Control	Function
Receptacles J1338 through J1341	Provide input connections for diversity antenna system (par. 21c.).
Receptacle J1348	Provides connection to antenna input of receiver A.
Receptacle J1347	Provides connection to antenna input of receiver B.
Receptacle J1343	Provides connections to control circuits of Selector Control C-974/FRR–33.
Input power receptacle J1342	Provides method of connecting power input to antenna coupler.
Receptacle J1345	Provides connection to channel A rf sensitivity control circuit in Selector Control C–974/FRR–33.
Receptacle J1346	Provides connection to channel B rf sensitivity control circuit in Selector Control C–974/FRR–33.
Receptacle J1351	Provides connection to Autotune circuits in antenna coupler.

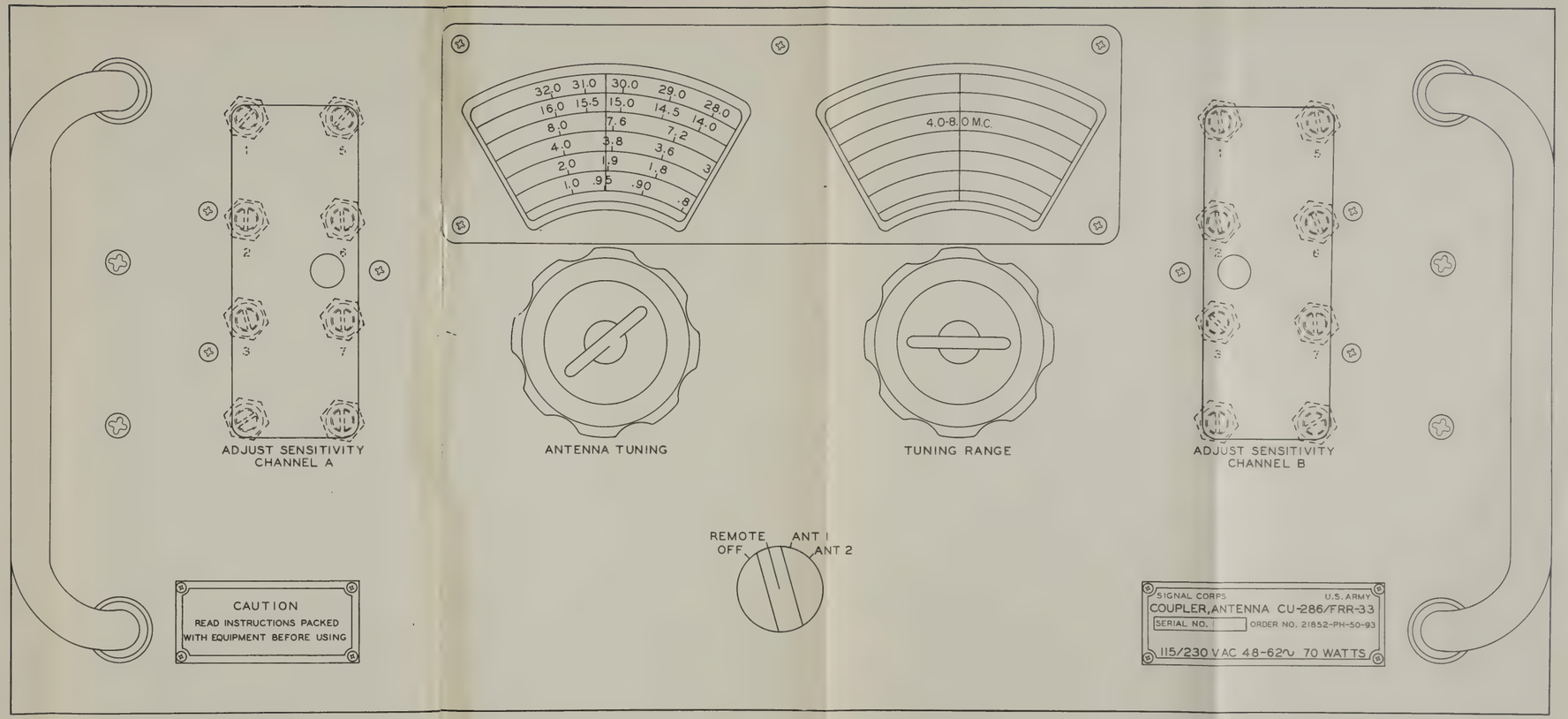

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Figure 38. Antenna Coupler CU-286/FRR-33, front panel controls.

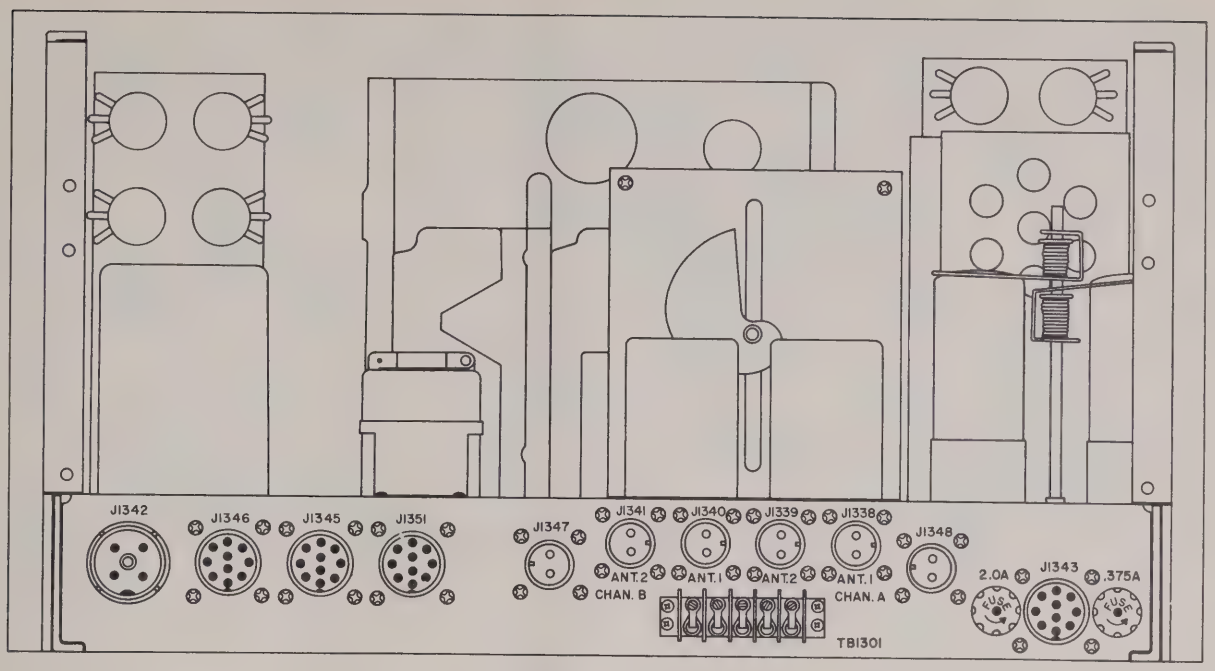

Figure 39. Antenna Coupler CU-286/FRR-33, rear chassis controls.

26. Radio Receiver R–391/URR Controls
(figs. 40 and 41)

The following table lists the receiver controls and indicates their function:

Control	Function
FUNCTION switch (S107)	When rotated to any position other than OFF connects the receiver to the power source and selects a desired receiver function. These positions and functions are as follows: Position — Function. STAND BY — Receiver is disabled but filaments remain lighted and oscillators remain on; receiver is ready for immediate use. AGC — Gain controlled automatically for normal reception. MGC — Agc (automatic gain control) disabled. Gain controlled manually by RF GAIN or by an external gain control. CAL — Calibration oscillator energized to supply signals at 100-kc points. SQUELCH — Squelch circuit is connected to silence the receiver when the signal is below a predetermined threshold. Threshold is determined by setting of RF GAIN control.
AGC SLOW–MED.–FAST time constant switch (S104)	Determines how rapidly a change of signal strength will change the rf gain of the receiver.
LOCAL GAIN control (R104)	Controls the level of the audio-frequency signal applied to the PHONES jack and the LOCAL AUDIO output terminals.
RF GAIN control (R123)	Controls sensitivity of rf and if amplifiers. When squelch is operative, controls threshold of squelch circuit.
BFO PITCH control (Z502)	Varies the frequency of the beat-frequency oscillator.
BFO OFF–ON switch (S103)	In ON position places bfo in operation.

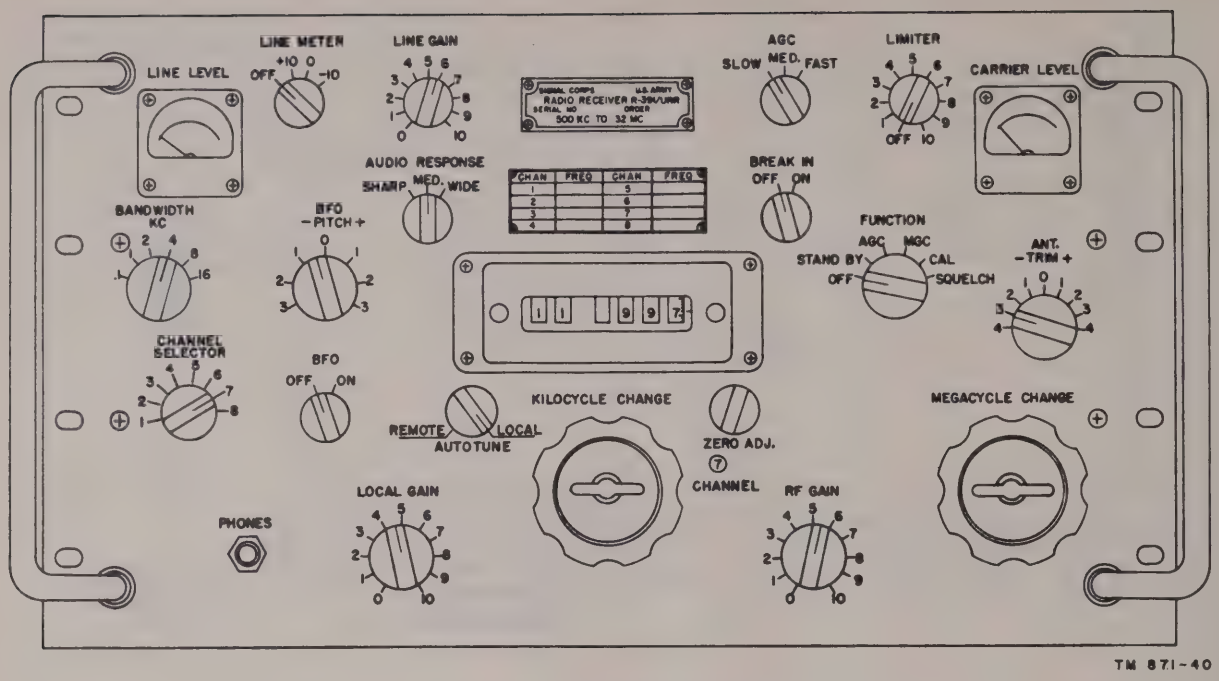

Figure 40. Radio Receiver R-391/URR, front panel controls.

26. Radio Receiver R–391 / URR Controls (cont)

Control	Function
LIMITER OFF–ON switch and threshold control (S105 and R124)	In ON position, peak signal impulses are cut off to reduce static interference. Increased reduction of signal peaks is obtained in the clockwise positions of the control.
BANDWIDTH switch (S501)	Changes the selectivity in KC of the 455-kc if amplifier stages.
MEGACYCLE CHANGE tuning control	Selects one of the 32 tuning steps. Changes the reading of the first two digits of the frequency indicator dial. The tuning may be done manually when the locking key is turned counterclockwise. When the key is turned fully clockwise, the control is locked and is under the control of the autotune.
KILOCYCLE CHANGE tuning control	Tunes receiver to the frequency within a band and changes reading of the last three digits on the frequency indicator dial. The tuning may be done manually when the locking key is turned counterclockwise. When the key is turned fully clockwise, the control is locked and is under the control of the autotune. The frequency range of the control is slightly greater than 1 mc. When the control is tuned to a frequency higher or lower than that indicated by the first two digits, a plus or minus sign is displayed in the space between the megacycle and kilocycle readings indicating (respectively) of one megacycle in reading of first two digits to obtain true reading.
ZERO ADJ. control	When turned clockwise, disengages frequency-indicator dial from KILOCYCLE CHANGE control for calibration purposes.
CHANNEL SELECTOR (S110)	Provides for selection of any one of eight preset channel frequencies. The frequency corresponding to any one of those channels may be readily changed to any frequency within the range of .5 mc to 32 mc.
CHANNEL indicator	Indicates channel position of Autotune system.
ANT TRIM control (C231)	Tunes the antenna circuit for maximum sensitivity by tuning out the reactive components of the antenna.
AUTOTUNE REMOTE–LOCAL switch (S109)	Provides for Autotune operation from a remote or local position.

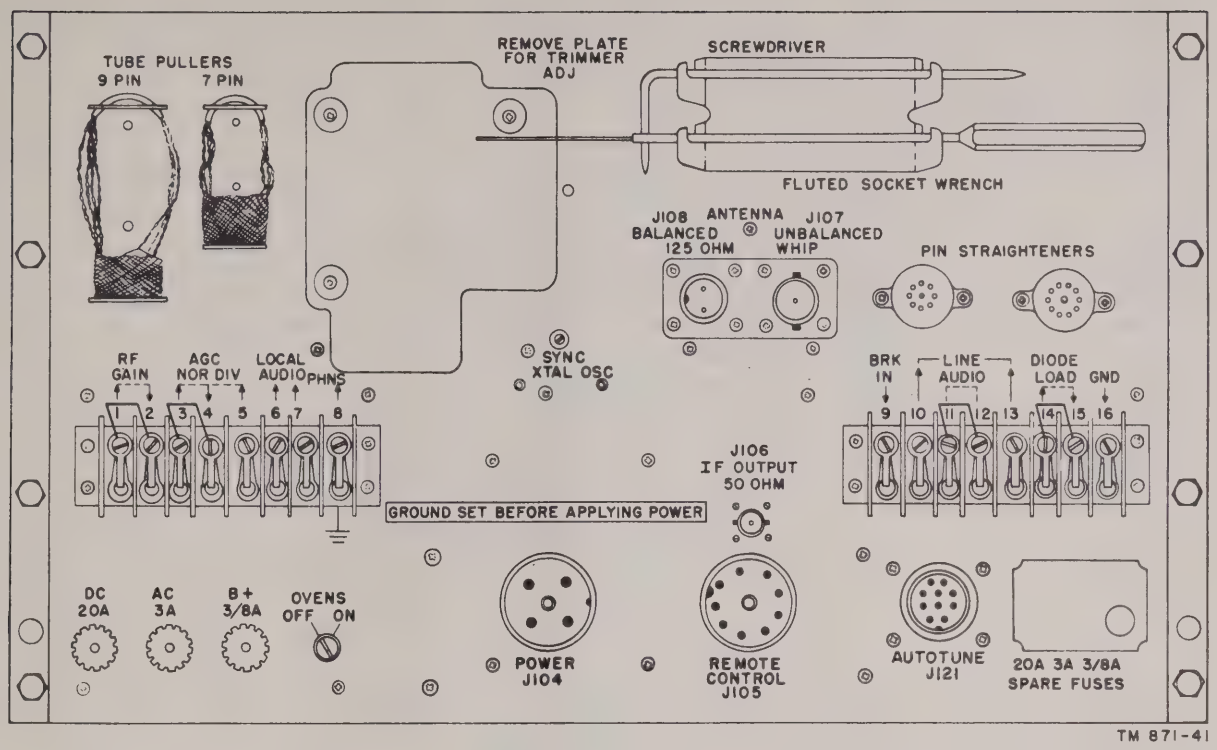

Figure 41. Radio Receiver R-391/URR, rear chassis controls.

Control	Function
AUDIO RESPONSE switch (S102)	Varies response of audio amplifier. In the SHARP position, an 800-cps band-pass filter is inserted into the audio circuit; in the MED position, a 3500-cps low-pass filter is inserted; in the WIDE position, no filter is used.
LINE GAIN control (R103)	Controls the level of the audio frequency signal applied to the balanced-line output terminals.
LINE LEVEL meter (M101)	Indicates level of balanced-line output.
LINE METER off-on and range switch (S101)	In the OFF position, the switch disconnects the LINE LEVEL meter from the output of the balanced line. In position +10, 10 db is to be added to the LINE LEVEL volume units (vu) reading; in position 0, the LINE LEVEL output meter is read directly in vu; in position −10, 10 db is to be subtracted from the LINE LEVEL vu reading.
BREAK IN OFF–ON relay switch (S106)	In the ON position, the break-in relay control-circuit is connected to REMOTE CONTROL receptacle J105 and balanced-line output is disconnected from J105.
CARRIER LEVEL meter (M102)	Indicates the level of incoming rf signal. A reading of 0 db when the RF GAIN control is fully on corresponds to an input signal of 2 to 5 microvolts.
OVENS OFF–ON switch (S108)	In ON position, completes heater circuits for oscillator ovens.
PHONES jack (J103)	Provides means of connecting headset to local audio output.
POWER receptacle J104	Provides means of connecting 115 or 230 volts ac to the receiver.
AUTOTUNE receptacle (J121)	Provides connection for remote control of Autotune system.
IF OUTPUT jack (J106)	Provides 455–kc signal for auxiliary equipment.
UNBALANCED WHIP ANTENNA receptacle J107	Provides connection for whip or random length antenna.

26. Radio Receiver R–391/URR Controls (cont)

Control	Function
BALANCED ANTENNA 125 OHM receptacle J108	Provides connection for balanced antenna or unbalanced low-impedance transmission lines.
115/230V AC switch (S801) (located in Power Supply PP–621/URR)	Provides selection of 115 or 230V AC operation.
Terminal strip TB102	
Terminal 1	Provides connection for external control of rf gain. Provides manual rf gain control when connected to terminal 2.
Terminal 2	Provides connection for external control of rf gain.
Terminal 3	Provides normal agc, when connected by a jumper to terminal 4.
Terminal 4	Provides connection for external agc to agc line when jumper is removed.
Terminal 5	Provides connection to receiver agc voltage for external application.
Terminal 6	Provides connection for local audio output.
Terminal 7	Provides ground connection.
Terminal 8	Provides connection for reduced local audio output when used with headset.
Terminal Strip TB101	
Terminal 9	Provides connection for break-in operation.
Terminal 10	Provides connection of line audio to balanced line.
Terminal 11	Provides connection for external balancing circuit, or is connected to terminal 12.
Terminal 12	Provides connection for external balancing circuit, or is connected to terminal 11.
Terminal 13	Provides connection of line audio to balanced line.
Terminal 14	Provides connection for external detector diode load (negative), or is connected to terminal 15.
Terminal 15	Provides connection for internal detector diode load to external detector, or is connected to terminal 14.
Terminal 16	Provides connection to ground.
REMOTE CONTROL receptacle J105	
Pin A	Balanced line audio output through BREAK IN switch S106.
Pin B	Break-in relay control circuit.
Pin C	No connection.
Pin D	Provides connection for 24 volts dc for Autotune motor.
Pin E	Ground.
Pin F	No connection.
Pin H	Reduced local audio output for headset.
Pin J	Balanced line audio output through BREAK IN switch S106.
Pin K	Carrier control circuit.

27. Selector Control C–974/FRR–33 Controls
(figs. 42 and 43)

The following table lists the selector control unit controls and indicates their function:

Control	Function
OFF–LOCAL–REMOTE	Position — Function OFF.....De-energizes selector control LOCAL.....Energizes power supply. Grounds grid of second impulse amplifier. Connects local dial (S1403) in circuit. Provides ground return for sections 4 and 5 of stepping relay (K1402). REMOTE.....Removes ground from grid of second impulse amplifier. Removes local dial from circuit. Prepares a circuit to home stepping-relay in the event wrong prefix number is dialed.
Telephone-type dial (S1403)	Operates to provide impulses for local selection of channels and functions.

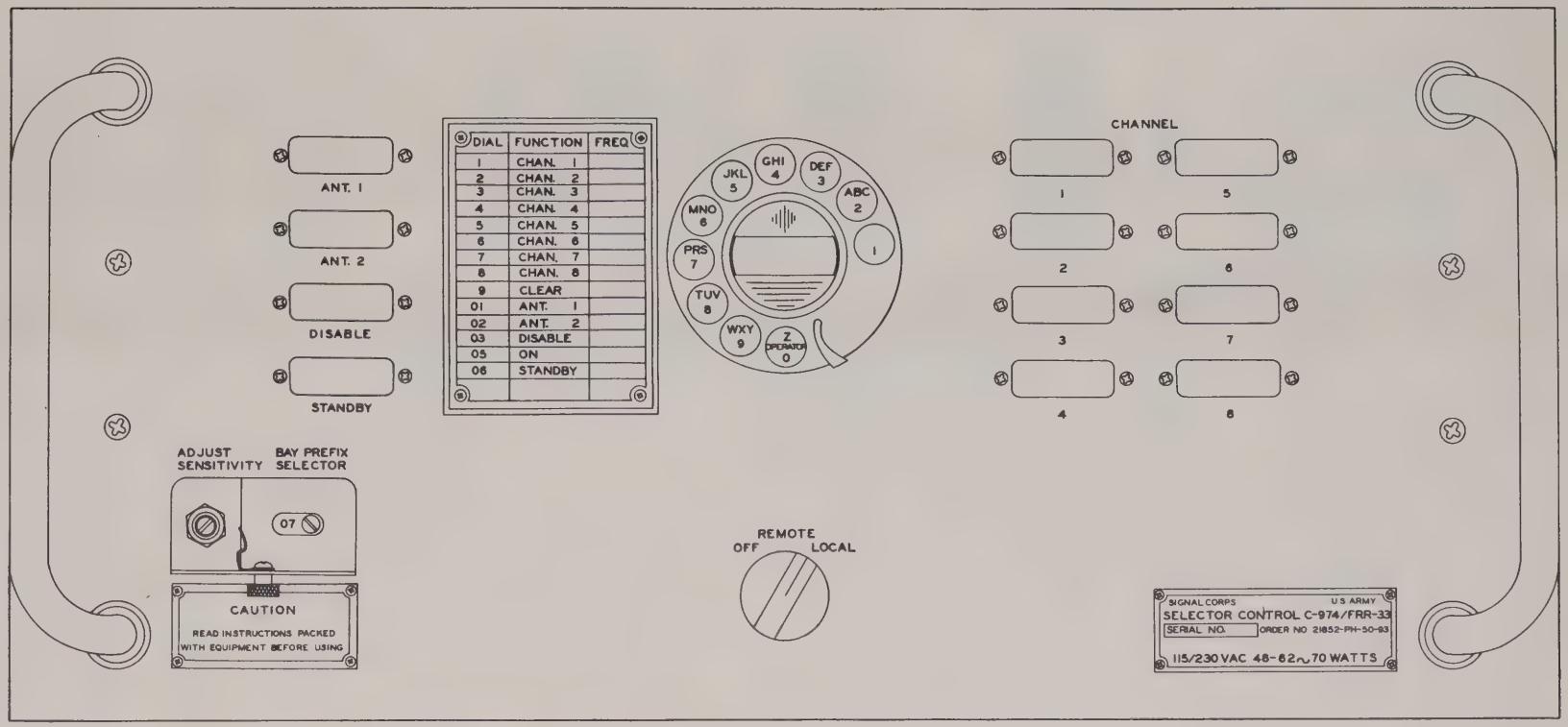

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Figure 42. Selector Control C-974/FRR-33, front panel controls.

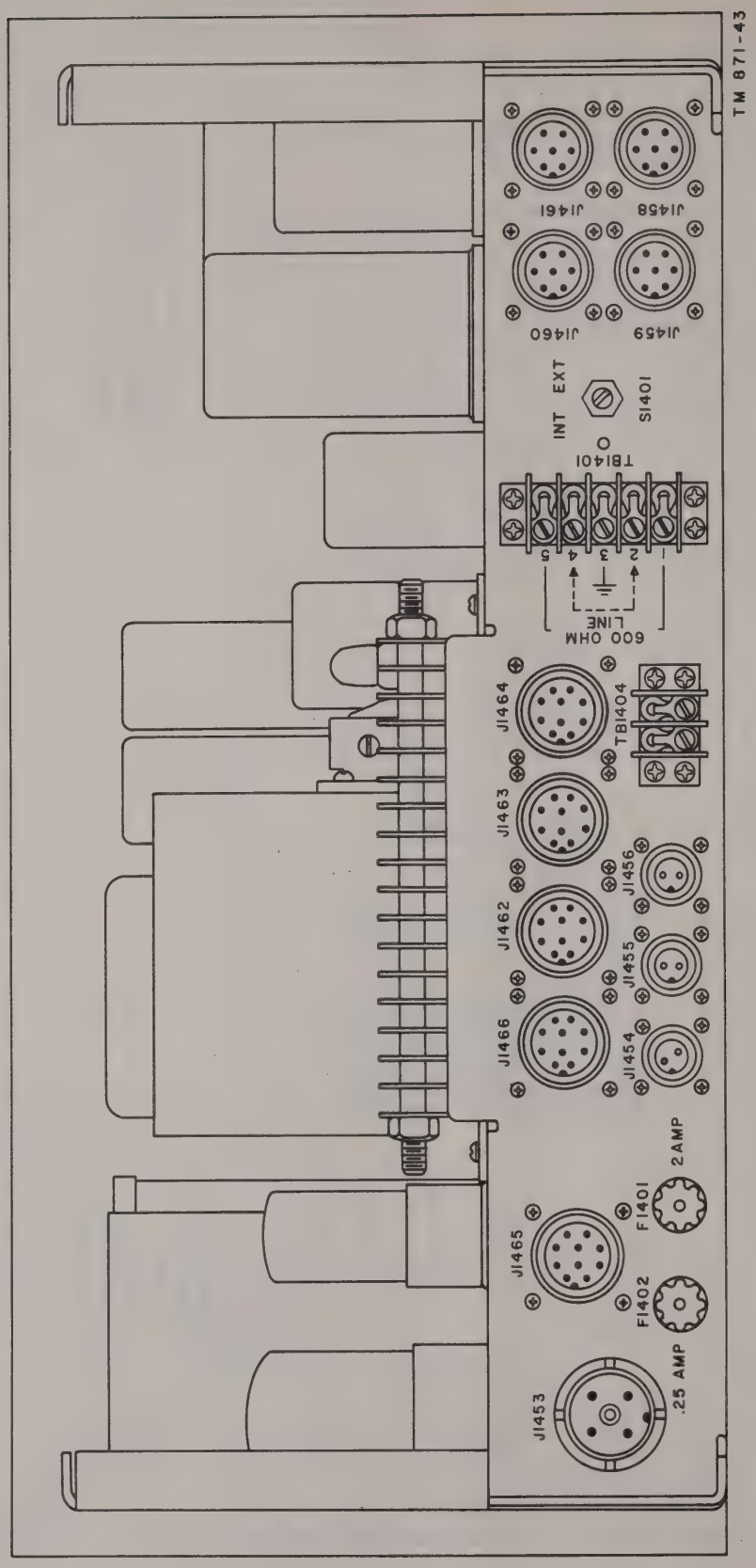


Figure 43. Selector Control C-974/FRR-33, rear chassis controls.

Control	Function
ADJUST SENSITIVITY control (R1402)	Is a potentiometer to adjust amplitude of impulses received from remote control station.
BAY PREFIX SELECTOR control (S1404)	Provides selection of prefix number to be dialed in order to operate equipment from remote station.
Indication lamps (I 1402 through I 1413)	Indicate operation of a particular channel or function circuit.
INT–EXT switch (S1401)	In INT position completes circuits for normal local or remote operation. In EXT position completes circuits for external impulse control when operating with an external impulse source.
B+ VOLTAGE ADJUSTMENT control (R1430)	Is a screwdriver adjustment to set output voltage of power supply to proper voltage.
115/230 V ac switch (S1406)	In 115-volt position connects primary windings of transformer T1402 in parallel; in 230-volt position connects windings in series.
Fuses F1401 (2 AMP) and F1402 (.25 AMP)	Fuse F1401 is a line fuse. Fuse F1402 protects B+ circuits.
Terminal board TB1401	Provides input connections for 600-ohm remote control telephone line with tone impulses from remote switching control.
Terminal board TB1404	Provides connections for external tone impulse control.
Input power receptacle J1453	Provides method of connecting power input to selector control.
Receptacle J1454	Provides connection to receiver control muting circuit.
Receptacles J1455 and J1456	Provide connections to supply Autotune power to receivers.
Receptacle J1458	Provides connections to function control circuits in radioteletype terminal equipment.
Receptacle J1459	Provides connections to function control circuits in antenna coupler.
Receptacles J1460 and J1461	Provide connections to function control circuits in receivers.
Receptacle J1462	Provides connections to Autotune control circuit in antenna coupler.
Receptacles J1463 and J1464	Provide connections to receiver rf sensitivity circuits.
Receptacles J1465 and J1466	Provide connections to receiver Autotune circuits.

28. Receiver Control C–975/URR Controls
(figs. 44 and 45)

The controls of the receiver control and their functions are listed in the following chart:

Control	Function
OFF–BFO–AFC switch (S1501)	Position — Function OFF . . . . . De-energizes receiver control. BFO . . . . . Completes circuit for operation of receivers using their internal beat-frequency oscillators. AFC . . . . . Connects afc circuits to each receiver.
CHANNEL A (or B) AFC ON indicator lamp (I 1501 or I 1502)	Indicates functioning of afc circuit to the extent that the afc hold relay is energized.
AFC THRESHOLD control (R1551 or R1564)	One potentiometer in each channel to adjust if. input voltage level necessary to operate the afc hold relay control circuit.
DISCRIMINATOR FREQUENCY control (R1535 or R1628)	One potentiometer in each channel to adjust the audio frequency which the afc circuit will attempt to maintain.
AFC DISCHARGE switch (S1502 or S1505)	One switch in each channel to short the afc time delay network when desired.
METER SWITCH A–OFF–B (S1504)	Completes meter circuit for either channel, depending on setting.
Meter (M1501)	Indicates approximate correction (in kc) provided by the particular afc channel selected by METER SWITCH A–OFF–B.
METER ZERO control (R1579)	Enables meter M1501 to be zeroed under static conditions.
ADJUST FILAMENT control (R1646)	Is a potentiometer to adjust the regulated filament voltage to 6.3 volts.
6.3V RMS test jack (J1577)	Provides test point to check output of regulated filament voltage power supply.
IF. INPUT CHANNEL A receptacle J1567	Provides method of connecting if. signal from receiver A to receiver control.

28. Receiver Control C–975/URR Controls (cont)

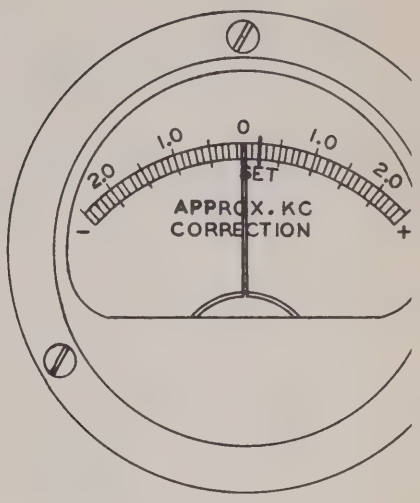
Control	Function
IF. INPUT CHANNEL B receptacle J1568	Provides method of connecting if. signal from receiver A to receiver control.
B+ 180V test jack (J1569) (top of chassis)	Provides test point to check output of regulated high-voltage power supply.
HUM BALANCE control (R1583) (top of chassis)	Is a potentiometer to adjust for minimum hum level in the output of the high-voltage power supply.
Bfo tuning capacitors (C1598 and C1603) (top of chassis)	Screwdriver adjustments to adjust the frequency of the bfo in each channel.
115/230 V switch (S1503) (top of chassis)	In 115-volt position connects primary windings of transformer T1509 in parallel; in 230-volt position connects windings in series.
Indicator lamps (I 1501 and I 1502)	Indicates functioning of afc circuits.
Input power receptacle J1570	Provides method of connecting power input to receiver control.
Filament voltage test jack (J1577)	Provides test point to check 6.3-volt filament supply.
Fuses F1501 and F1502	Fuse F1501 is a line fuse. Fuse F1502 protects B+ circuits.
Receptacle J1571	Provides connection for remote control of rectifier CR1502 ground circuit.
Terminal board TB1501	Provides audio output connections of the receiver control and completion of diode detector circuits in the receivers.

NEL A
ON

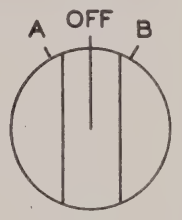
RESHOLD

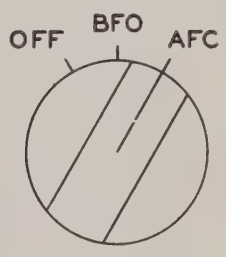
OR FREQUENCY

AFC DISCHARGE



METER SWITCH





28. Receiver Control C–975/URR Controls (cont)

Control	Function
IF. INPUT CHANNEL B receptacle J1568	Provides method of connecting if. signal from receiver A to receiver control.
B+ 180V test jack (J1569) (top of chassis)	Provides test point to check output of regulated high-voltage power supply.
HUM BALANCE control (R1583) (top of chassis)	Is a potentiometer to adjust for minimum hum level in the output of the high-voltage power supply.
Bfo tuning capacitors (C1598 and C1603) (top of chassis)	Screwdriver adjustments to adjust the frequency of the bfo in each channel.
115/230 V switch (S1503) (top of chassis)	In 115-volt position connects primary windings of transformer T1509 in parallel; in 230-volt position connects windings in series.
Indicator lamps (I 1501 and I 1502)	Indicates functioning of afc circuits.
Input power receptacle J1570	Provides method of connecting power input to receiver control.
Filament voltage test jack (J1577)	Provides test point to check 6.3-volt filament supply.
Fuses F1501 and F1502	Fuse F1501 is a line fuse. Fuse F1502 protects B+ circuits.
Receptacle J1571	Provides connection for remote control of rectifier CR1502 ground circuit.
Terminal board TB1501	Provides audio output connections of the receiver control and completion of diode detector circuits in the receivers.

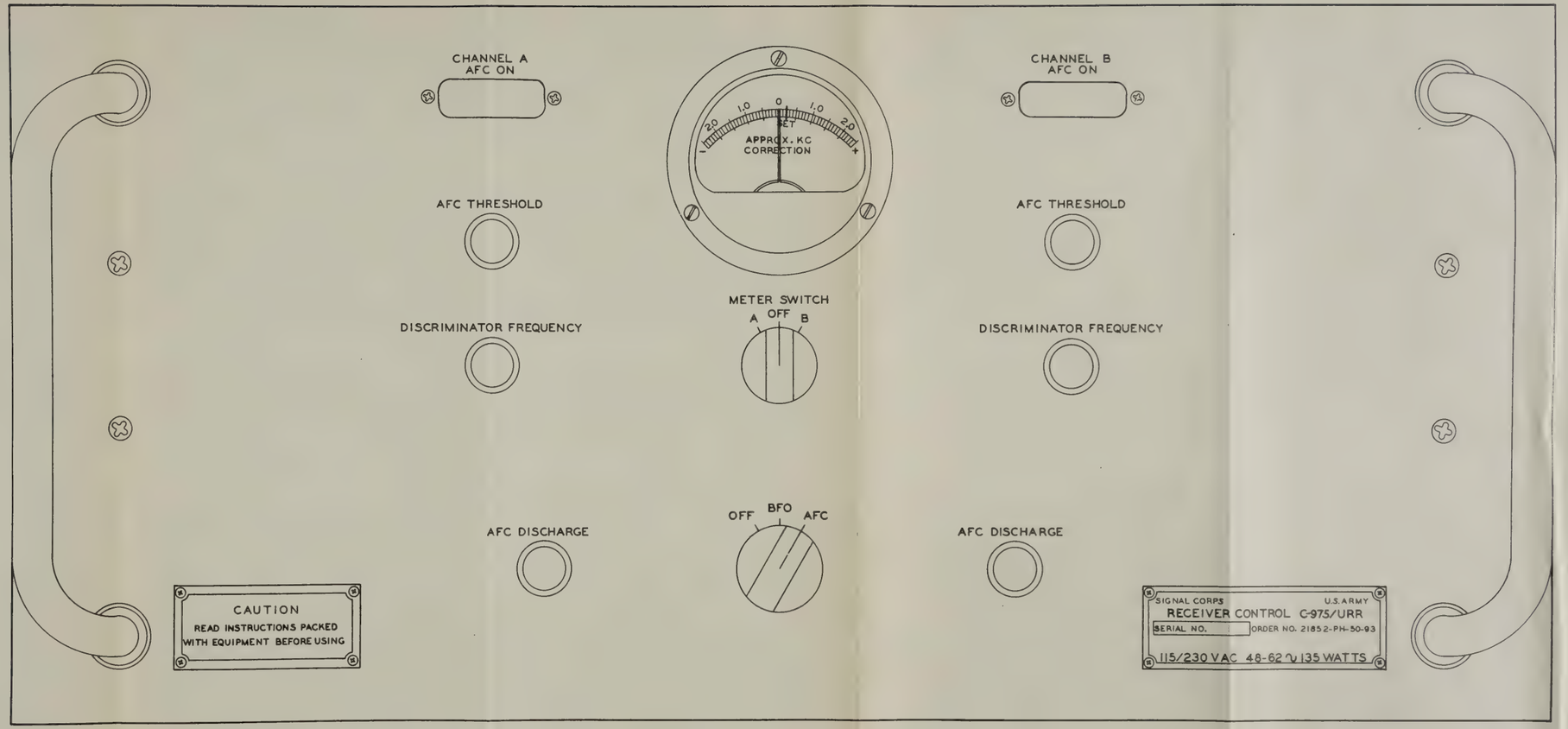


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Figure 44. Receiver Control C-975/URR, front panel controls.

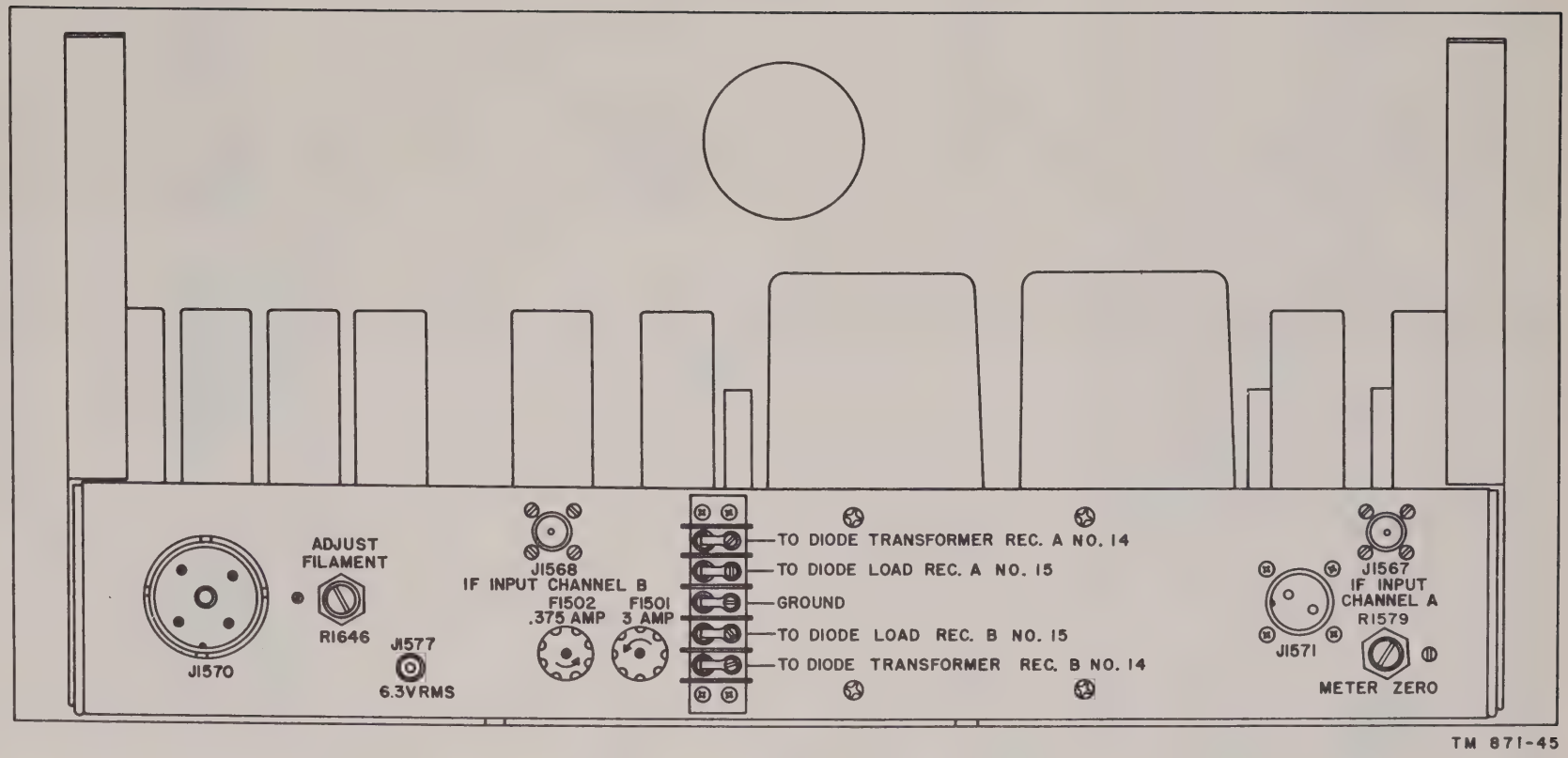

Figure 45. Receiver Control C-975/URR, rear chassis controls.

29. Power Supply PP–629/URR Controls
(figs. 46 and 47)

The following table lists the power supply controls and indicates their function:

Control	Function
ON–OFF switch (S1102)	In ON position, connects primary of power transformer to source of ac power.
115/230V switch (S1101) (top of chassis)	In 115-volt position, connects primary windings of transformer T1101 in parallel; in 230-volt position, connects windings in series.
Pilot Lamp (I 1101)	Indicates presence of power in power supply.
Fuses F1101 10A and F1102 10A	Fuses F1101 and F1102 are line fuses.
Terminal board TB1101	Provides output connection for 24 volts.
Power input receptacle (J1131)	Provides method of connecting input power to power supply.
Receptacle J1132	Provides connection to 24 volt dc and 115 or 230 volt ac.
Receptacles J1133 through J1135	Provides connection to 24 volt dc output.

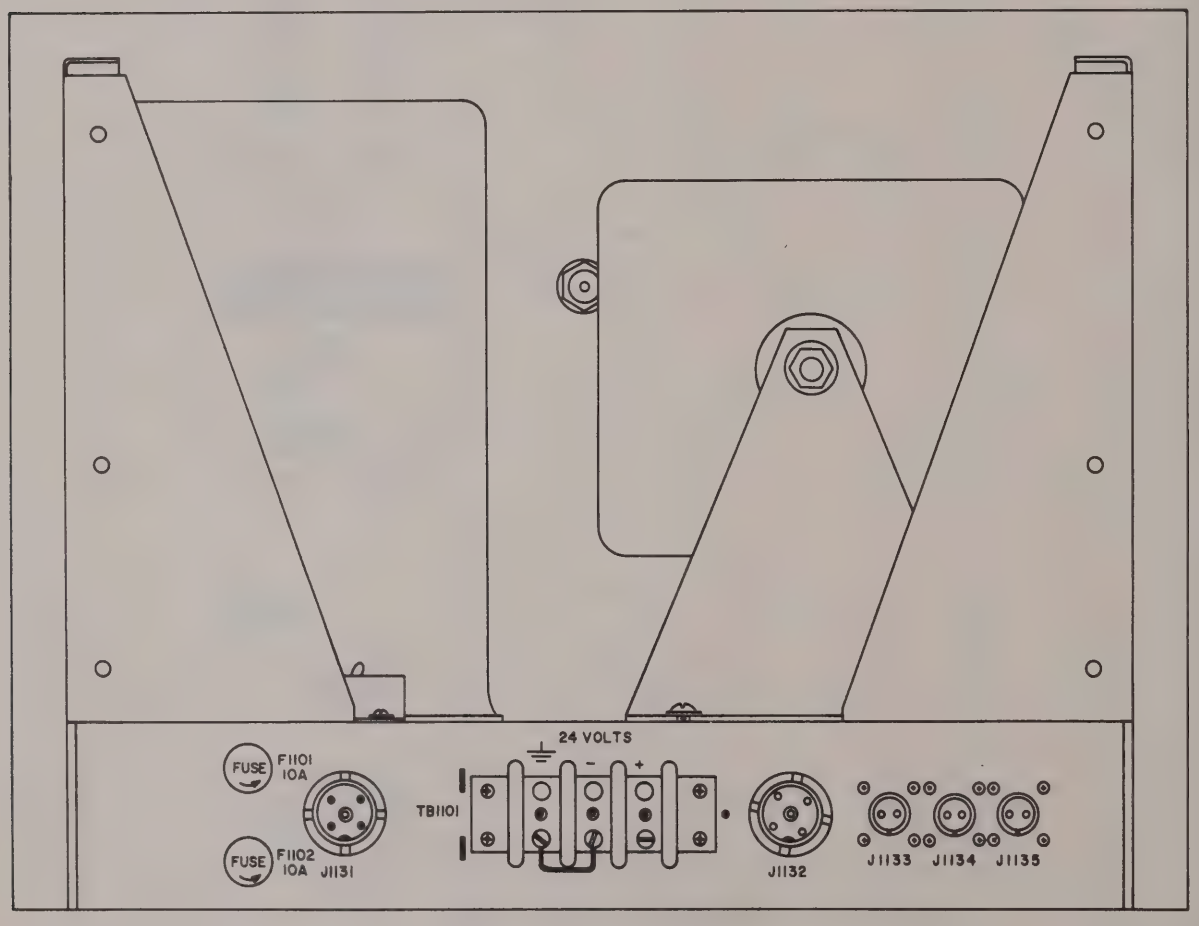

Figure 47. Power Supply PP-629/URR, rear chassis controls.

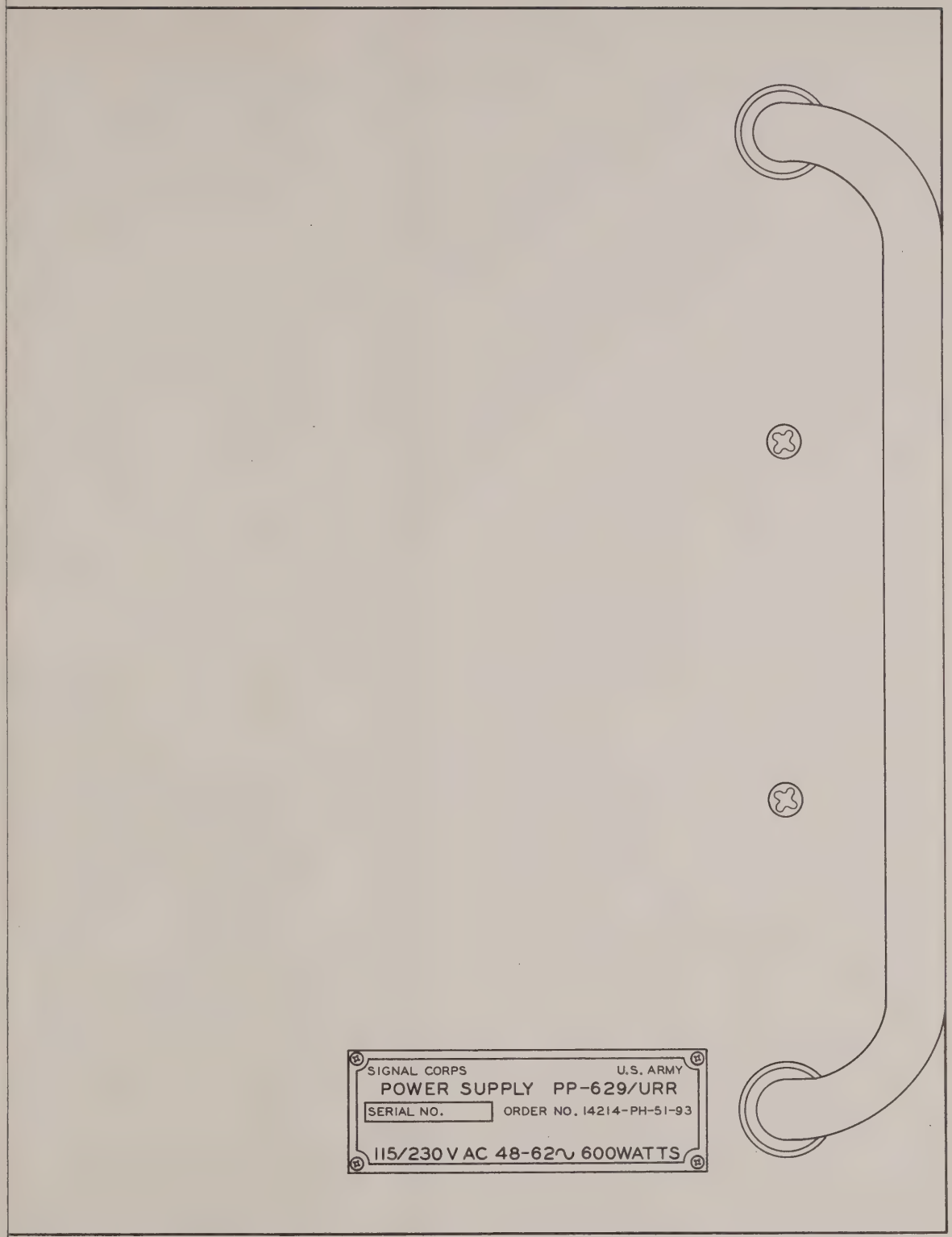

Figure 46. Power Supply PP-629/URR, front panel controls.

29. Power Supply PP–629/URR Controls
(figs. 46 and 47)

The following table lists the power supply controls and indicates their function:

Control	Function
ON–OFF switch (S1102)	In ON position, connects primary of power transformer to source of ac power.
115/230V switch (S1101) (top of chassis)	In 115-volt position, connects primary windings of transformer T1101 in parallel; in 230-volt position, connects windings in series.
Pilot Lamp (I 1101)	Indicates presence of power in power supply.
Fuses F1101 10A and F1102 10A	Fuses F1101 and F1102 are line fuses.
Terminal board TB1101	Provides output connection for 24 volts.
Power input receptacle (J1131)	Provides method of connecting input power to power supply.
Receptacle J1132	Provides connection to 24 volt dc and 115 or 230 volt ac.
Receptacles J1133 through J1135	Provides connection to 24 volt dc output.

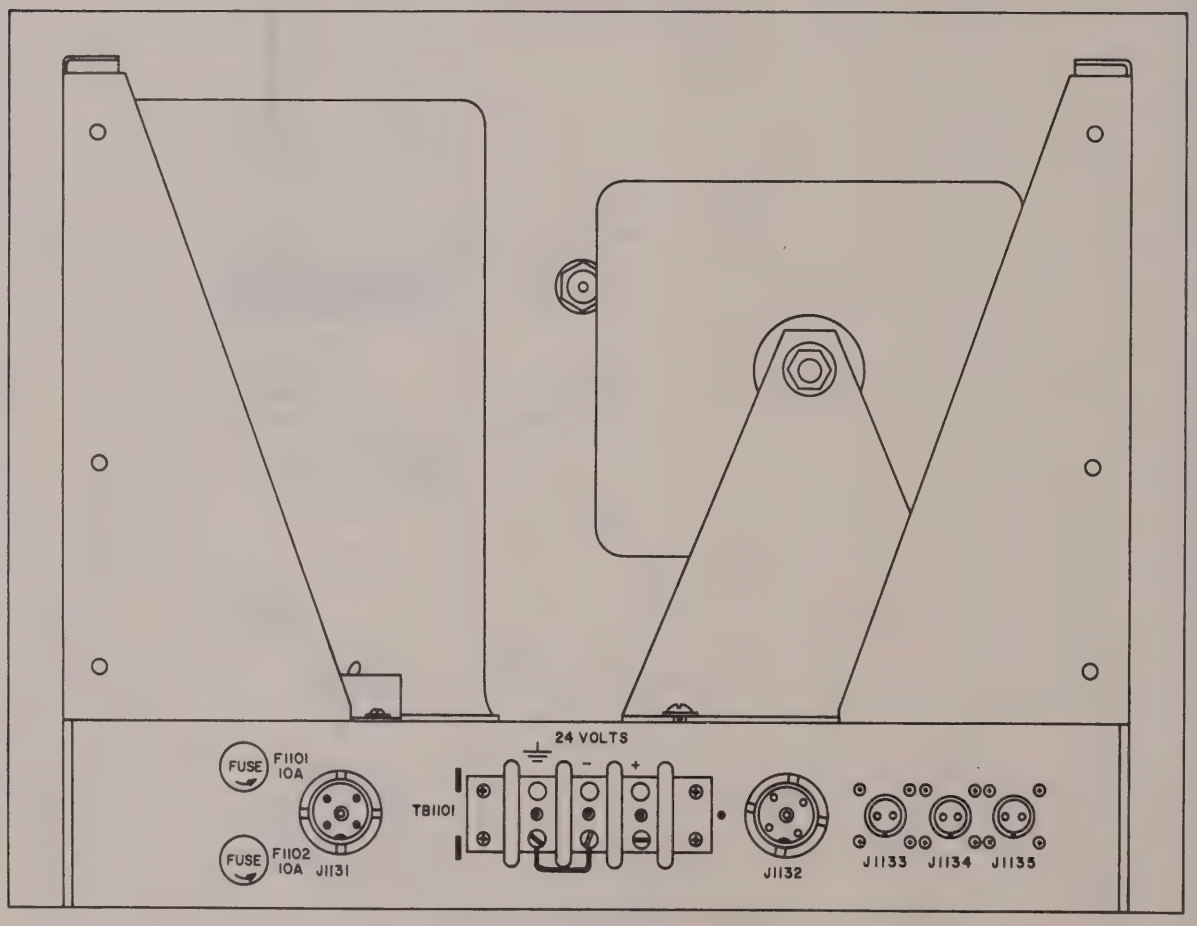

Figure 47. Power Supply PP-629/URR, rear chassis controls.

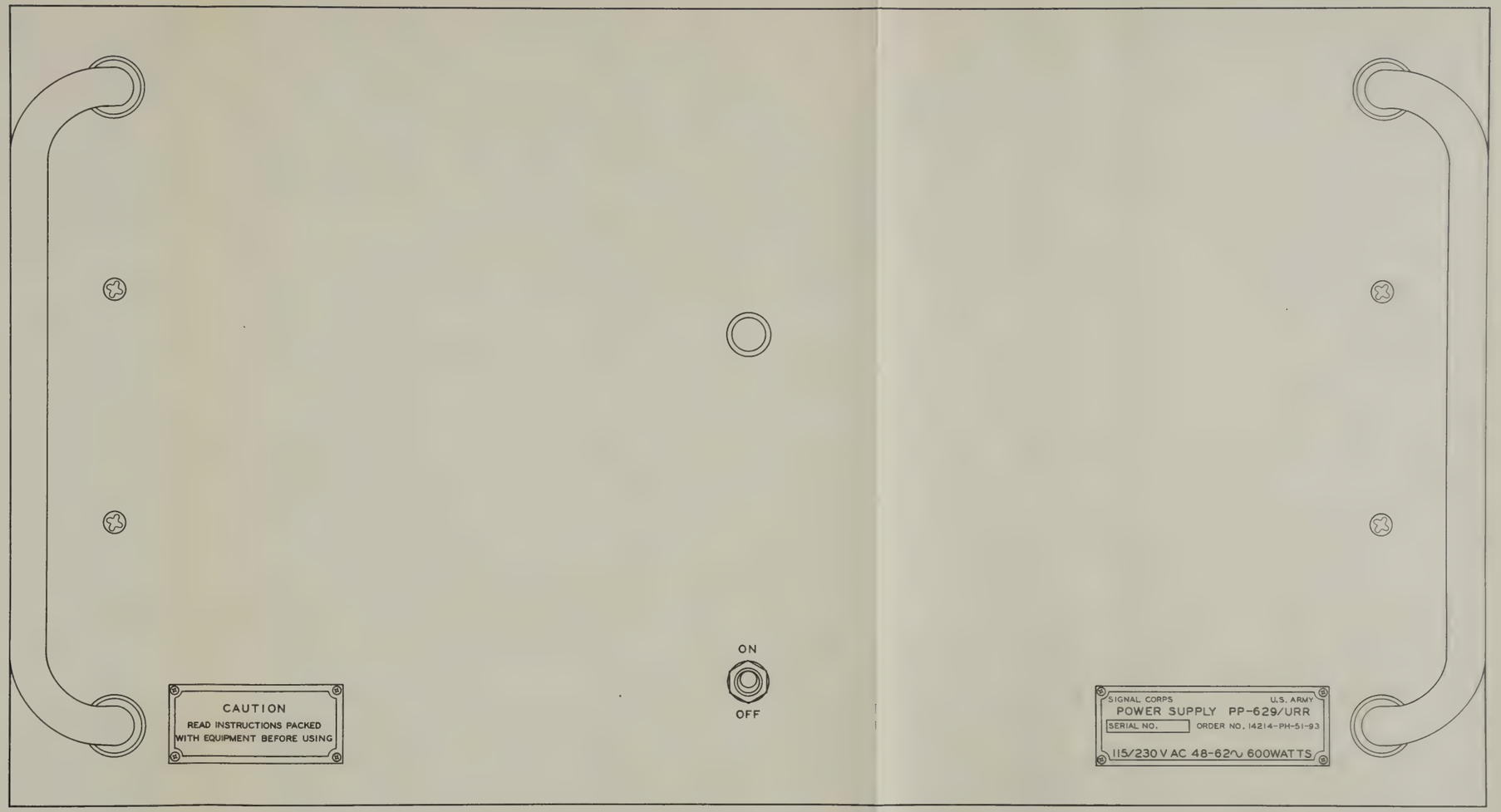

Figure 46. Power Supply PP-629/URR, front panel controls.

30. Remote Switching Control C–973/FRR–33 Controls
(figs 48 and 49)

The following table lists the remote switching control unit controls and indicates their function:

Control	Function
OFF–STDBY–ON switch (S1203)	Position — Function OFF — De-energizes remote switching control. STDBY — Energizes power supply circuit, but disables impulsing and tuning indicator circuits. ON — Removes disabling circuits.
Telephone-type dial (S1201)	Operates impulsing circuit for remote selection of channels and functions. Operates circuit to provide tuning indication.
Output level control (R1205)	Is a potentiometer to adjust level of outgoing impulses.
TONE INT–EXT switch (S1202)	In EXT position disables af oscillator and connects local dial interrupter springs to receptacle J1136.
Terminal board TB1201	Provides tone pulse output connections to balanced 600-ohm telephone line, to the selector control.
FUSES F1201 1.0A and F1202 .25A	Fuse F1201 is a line fuse. Fuse F1202 protects B+ circuits.
Terminal board TB1205	Provides connections for external tone impulse control circuit.
Input power receptacle (P1201)	Provides method of connecting power input to remote switching unit.
B+ voltage adjustment control (R1221)	Is a potentiometer to set output voltage of power supply to proper voltage.
POWER indicator lamp (I 1201)	Indicates presence of ac power in unit.
TUNING IN PROGRESS indicator lamp (I 1202)	Indicates delay necessary after dialing a channel or function while tuning motors in radio receiving set return to normal position.
115/230 V ac switch (S1204)	In 115-volt position, connects primary windings of transformer T1202 in parallel; in 230-volt position, connects windings in series.

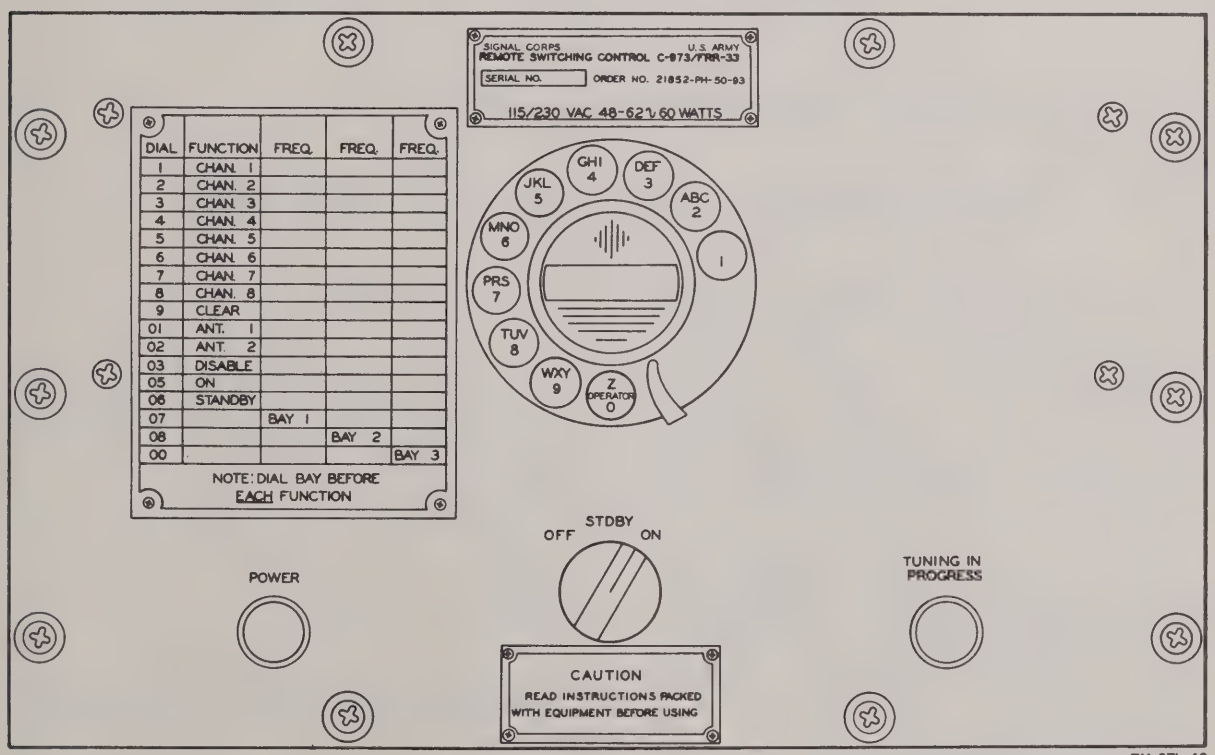

Figure 48. Remote Switching Control C-973/FRR-33, front panel controls.

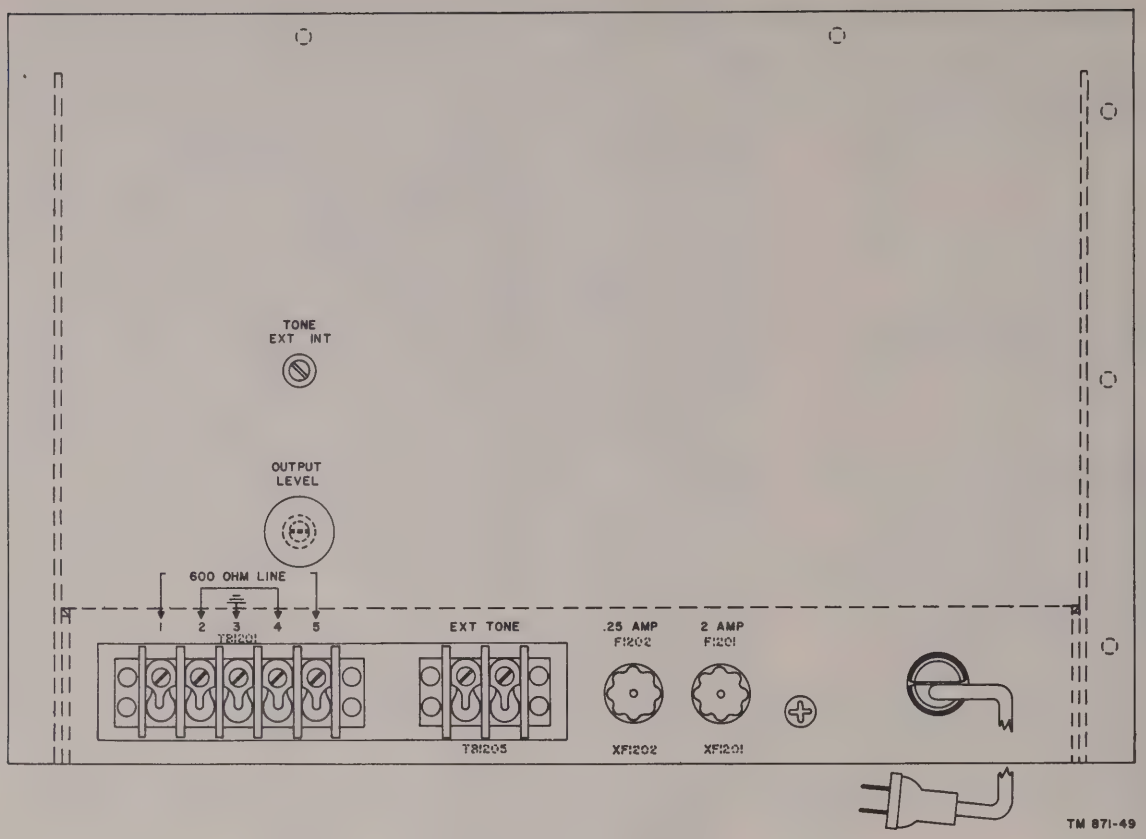

Figure 49. Remote Switching Control C-973/FRR-33, rear chassis controls.

Section III. INITIAL ADJUSTMENTS AND PRESETTING

31. Calibration of Radio Receiver R–391/URR

To maintain the tuning accuracy of the receivers when presetting the eight channels or whenever the receiver is tuned to a different frequency, calibrate the frequency indicator of each receiver at the 100-kc point nearest the frequency desired for reception. Calibration is accomplished by the use of the internal calibration oscillator as follows:

a. Rotate locking keys, located in center of MEGACYCLE CHANGE and KILOCYCLE CHANGE control knobs, approximately two turns counterclockwise.

b. Set the BANDWIDTH switch to the .1-KC position.

c. Set AUDIO RESPONSE to MED.

d. Set LOCAL GAIN control to 5.

e. Set the BFO switch to ON.

f. Turn FUNCTION switch to CAL.

g. Set OFF-BFO-AFC switch (on receiver control) to BFO.

h. Adjust MEGACYCLE CHANGE and KILOCYCLE CHANGE controls for a reading on the frequency indicator at the 100-kc point nearest the frequency desired for reception.

i. Turn the ZERO ADJ. control clockwise as far as it will go.

j. Rotate ANT. TRIM to obtain an indication on the CARRIER LEVEL meter.

k. Adjust KILOCYCLE CHANGE control for maximum indication on the CARRIER LEVEL meter. Maximum should be obtained with only a slight adjustment of the control in either direction. If a maximum reading is not obtained within the limits of travel of the KILOCYCLE CHANGE control, as set by the ZERO ADJ.

knob, the vfo tuning shaft must be rotated a small amount. Refer to the instruction book covering the receiver for the correct procedure.

l. Turn the BFO PITCH control to obtain a zero beat.

m. Turn the ZERO ADJ. control counterclockwise to stop. The dial is now calibrated accurately.

32. Initial Adjustment of Receiver Control C–975/URR

The following adjustments should be made after the initial installation, after replacement of a unit for repairs, etc. The adjustments should be checked periodically, the frequency of checking depending upon the operating time of the equipment. Under normal operating conditions, a check once a month should be sufficient.

a. Place 115/230 V switch S1503 in the position corresponding to the supply voltage.

b. Turn OFF-BFO-AFC switch to BFO.

c. Place the test leads of a 0-10 volt iron-vane ac voltmeter (Weston 476, or equal) between 6.3 V RMS test jack J1577 and chassis ground.

Note. This ac voltmeter must be an iron-vane type meter or an incorrect setting of the regulated filament voltage will result.

d. Place ADJUST FILAMENT control R1646 in the position to give a 6.3-volt reading on the ac voltmeter.

e. Place the vertical input leads of an oscilloscope (Oscilloscope OS-8A/U, TM 11-1214, or equal) between B+ 180 V test jack J1569 (top of chassis) and chassis ground.

f. Adjust HUM BALANCE potentiometer R1583 for minimum hum level as indicated by the oscilloscope.

g. Place METER SWITCH A-OFF-B in the OFF position.

h. Adjust METER ZERO potentiometer R1579 for a zero meter reading.

33. Preoperational Tests and Adjustments

Preoperational tests and adjustments should be performed before placing Radio Receiving Set AN/FRR-33 in operation. The preoperational tests and adjustments are described in paragraphs 34 through 37. The use of patch cords and the frequency indicator METER of the radioteletype terminal equipment is discussed in TM 11-356, Radioteletype Terminal Equipment AN/FGC-1, AN/FGC-1C, and AN/FGC-1X.

34. Afc Threshold Sensitivity Adjustment

This adjustment need not be made every time the radio receiving set is placed in operation, but a periodic check should be made approximately once a month.

a. Calibrate Radio Receiver R-391/URR at the 900-kc position (par. 31). Then calibrate a signal generator such as RF Signal Generator Set AN/URM-25 against the radio receiver. This is accomplished by feeding a 455-kc signal from the signal generator into the receiver. Tune the receiver to 910 kc. Turn the BFO control to ON and listen for the resultant beat note. Adjust the signal generator for a zero beat. The second harmonic of the signal generator output actually is being checked in this case.

b. Couple the output of the calibrated signal generator into IF INPUT CHANNEL A receptacle J1567 in Receiver Control C-975/URR.

c. Adjust the signal generator for a 3-millivolt output.

Note. This is a loaded voltage. A properly terminated signal generator will develop one-half of the open-circuit voltage. Check the instruction book of the signal generator to determine if the output of the generator is calibrated in terms of open-circuit or properly terminated voltage. The input impedance of Receiver Control C-975/URR is 50 ohms.

d. Turn the channel A AFC THRESHOLD control to the position where CHANNEL A AFC ON lamp just lights.

e. Repeat steps *a* through *d* for channel B controls.

35. Calibration of Frequency Indicator Circuit of Radioteletype Terminal Equipment AN/FGC–1( )

The following procedure is for the purpose of adjusting the frequency indicator circuit so that zero indication is obtained on the meter when the mark frequency received from the receiver is 2,125 cps. All the controls listed in the following subparagraphs are on the radio receiver unless otherwise indicated.

a. Set the OFF-BFO-AFC control (on the receiver control) to BFO.

b. Plug a headset into the PHONES jack of one of the receivers.

c. Turn the METER switch (on the frequency indicator) to the D-C position.

d. Patch the D-C METER jack (on the frequency indicator) to the FREQ IND OUT jack. Use a cord equipped with three conductor plugs.

e. Turn the BFO switch to ON.

f. Set the BFO PITCH control to 0.

g. Rotate the Autotune locking keys on the ANTENNA TUNING and TUNING RANGE controls on the antenna coupler and the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls on the radio receiver approximately two turns counterclockwise.

h. Tune the antenna coupler and the radio receiver to the teletypewriter signal.

i. Adjust the KILOCYCLE CHANGE control to where the two tones are the same. This is halfway between the *mark* and *space* frequencies.

j. Tune the BFO PITCH control (normally clockwise) for a steady indication on the meter on the frequency indicator. (The proper setting of the BFO PITCH control should be just past 2.)

k. Set the LINE GAIN control for a 0-vu output.

l. Depress the FREQ IND CAL switch (on the frequency indicator) and hold it operated.

m. Adjust the ZERO ADJ control (on the frequency indicator) to obtain a reading of 0 on the meter.

n. Release the FREQ IND CAL switch.

o. Repeat the operations outlined in subparagraphs *j* through *n* above.

p. Insert the headset into the mark and space channel filter out jacks (M CH F and S CH F, respectively) of the proper channel on the detector. Signals should be heard at both jacks.

36. Afc Discriminator Frequency Adjustment

The following procedure is for the purpose of adjusting the afc circuit to maintain the mark frequency close to 2,125 cps. The procedure includes a test to determine whether the spread (difference) between the mark and space frequencies is 850 cps. The procedure is used separately with each receiver. Controls mentioned below refer to those of Radioteletype Terminal Equipment AN/FGC-1( ) unless otherwise indicated.

a. Calibrate the frequency indicator circuit (par. 35) if this has not been done already.

b. Turn the BFO switch (on the radio receiver) to OFF.

c. Turn the OFF-BFO-AFC switch (on the receiver control) to AFC.

d. Press and release the AFC DISCHARGE switch (on the receiver control), using the switch for the proper channel.

e. Set the LINE GAIN control (on the radio receiver) for a 0-vu reading on the LINE LEVEL meter.

f. Adjust DISCRIMINATOR FREQUENCY control (on the receiver control) of the proper channel to obtain a meter reading of 0 on the frequency indicator of the radioteletype equipment.

g. If the meter reading fluctuates more than ±5 during reception, readjust the DISCRIMINATOR FREQUENCY control.

h. If the steady meter reading exceeds ±15 during reception, the mark and space frequency spread differs from 850 cps by an unacceptable amount. Request the distant transmitter to make a spread adjustment. The type and magnitude of adjustment necessary is explained in (1) through (3) below.

(1) If the steady reading is to the right (positive), the frequency spread is too great.

(2) If the steady meter reading is to the left (negative), the frequency spread is too small.

(3) Six times the steady meter reading is the departure in cps from the desired (850 cps) frequency spread.

37. Receiver Control Bfo Frequency Adjustment

With normal operating conditions, the receiver control bfo frequency should be adjusted at least once a week. Aging of the reactance tube (V1508 or V1530) results in a 200 to 350-cps shift in bfo frequency per normal week of operation (based on continuous operation). This aging process is discussed further in the instruction book covering the receiver control. Use the following procedure in adjusting the bfo frequency.

a. Calibrate the receivers according to the procedure given in paragraph 31.

b. Leave the controls in the position used for calibration.

c. Set OFF-BFO-AFC switch in the AFC position.

d. Set METER SWITCH A-OFF-B to A.

e. Adjust channel A bfo capacitor C1603 until the kilocycle correction meter reads 0.

f. Set METER SWITCH A-OFF-B to B.

g. Adjust channel B bfo capacitor C1598 until the kilocycle correction meter reads 0.

Notes:

1. Meter M1501 should be zeroed before making the adjustments in subparagraphs *e* and *g* above.

2. To adjust capacitor C1603 or C1598, the receiver control dust cover must be removed. Remove the blank panel immediately above the receiver control. Remove the screws that hold the receiver control in place and slide the unit forward a few inches. This will allow sufficient room to reach both screws that hold the dust cover in position and the control shafts for adjusting C1603 and C1598.

3. A steady signal input may be used in this adjustment instead of using the calibration oscillator in the receiver. In this case, adjust the KILOCYCLE CHANGE control for a maximum indication on the CARRIER LEVEL meter and follow the same procedure as before.

38. Presetting Channels of Radio Receiving Set AN/FRR–33

Follow the procedure given below in presetting a channel:

a. Set the front panel controls as shown below.

b. Select the channel to be tuned and operate the dial on Selector Control C–974/FRR–33.

Note. One method to insure correct channel settings is to turn the ON-OFF switch on the front panel of Power Supply PP-629/URR to the OFF position after selecting the channel to be preset. This prevents accidental rotation of the Autotunes until tuning is complete and the locking keys are retightened.

c. Calibrate each radio receiver (par. 31).

d. Set the BANDWIDTH switch to 4 KC.

e. Set the BFO switch to OFF.

f. Turn the FUNCTION switch to AGC.

g. Set the OFF-BFO-AFC switch (on the receiver control) to AFC.

h. Loosen the Autotune locking keys on the ANTENNA TUNING and TUNING RANGE controls on the antenna coupler and the KILOCYCLE CHANGE and MEGACYCLE CHANGE controls on the receivers.

i. Set the tuning controls of the antenna coupler and the radio receivers to the teletypewriter signal for a peak reading on the CARRIER LEVEL meter.

j. Rotate the KILOCYCLE CHANGE control on each receiver to where the meter on the receiver control reads SET.

k. Tighten the Autotune locking keys on the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls on the radio receiver.

l. Adjust the ANTENNA TUNING control on the antenna coupler for a peak reading of the CARRIER LEVEL meter of each receiver. If the peak readings of the two meters do not occur at the same point of a particular setting of the ANTENNA TUNING control, estimate the average and use this.

m. Set the CHANNEL A and B ADJUST SENSITIVITY controls for the selected channel to give a +10 DB reading on each CARRIER LEVEL meter.

n. Tighten the Autotune locking keys on the ANTENNA TUNING and TUNING RANGE controls on the antenna coupler.

o. Dial the next channel to be tuned and repeat the procedure.

Component	Control	Position
Antenna Coupler CU–286/FRR–33	OFF–REMOTE–ANT 1–ANT 2	REMOTE
	ANTENNA TUNING and TUNING RANGE controls	Set at the desired frequency
	ANTENNA TUNING and TUNING RANGE Autotune locking keys	Tightened (fully clockwise)
Radio Receivers R–391/URR	KILOCYCLE CHANGE and MEGACYCLE CHANGE controls	Set to same frequency as antenna coupler
	KILOCYCLE CHANGE and MEGACYCLE CHANGE Autotune locking keys	Tightened (fully clockwise)
	FUNCTION	CAL
	AGC	MED
	LOCAL GAIN	5
	BFO	ON
	LIMITER	OFF
	BANDWIDTH	.1 KC
	ANT. TRIM	0
	AUTOTUNE	REMOTE
	LINE GAIN	5
	LINE METER switch	0
	AUDIO RESPONSE	MED.
	BREAK IN	ON
Selector Control C–974/FRR–33	BAY PREFIX SELECTOR	Authorized prefix
	OFF–LOCAL–REMOTE	LOCAL
	INT–EXT[a]	INT
Receiver Control C–975/URR	OFF–BFO–AFC	BFO
Power Supply PP–629/URR	ON–OFF	ON

[a] Located on rear of unit.

Section IV. OPERATION UNDER USUAL CONDITIONS

39. Preliminary Starting Procedure

Before operating the equipment, refer to installation and connection instructions given in paragraphs 20 and 21 and make sure all instructions have been followed. Set the front panel controls as shown below before using the starting procedure described in paragraph 40. Initial adjustments and presetting of channels should be done if necessary (pars. 31 through 38).

40. Starting Procedure

Note. If, during the starting or operating procedure, an abnormal result is obtained, see paragraph 60, equipment performance checklist.

a. Throw the main ac switch to ON.

b. Turn the OFF-REMOTE-ANT 1-ANT 2 switch on the antenna coupler to REMOTE.

c. Turn the FUNCTION switch on each radio receiver to AGC.

d. Turn the OFF-REMOTE-LOCAL switch on the selector control to LOCAL.

e. Turn the OFF-BFO-AFC switch on the receiver control to AFC.

f. Turn the ON-OFF switch on the power supply to ON.

g. Refer to paragraphs 41 through 46 for desired operating procedure.

41. Operation

Correct operation of Radio Receiving Set AN/FRR–33 depends, to a great extent, upon the experience of the operator and his ability to analyze the operating conditions at any given time. The settings of the controls will depend upon the operating conditions. A general procedure is given in paragraph 42. Various comments, operating precautions, and general operating procedures are then discussed in paragraphs 43 through 46.

42. Normal Diversity Operation

a. Local Operation.

(1) Follow the information given in paragraphs 39 and 40 in starting the equipment.

Component	Control	Position
Electrical Equipment Cabinet CY–1119/U	Main ac switch	OFF
Antenna Coupler CU–286/FRR–33	OFF–REMOTE–ANT 1 — ANT 2	OFF
Radio Receiver R–391/URR	FUNCTION AGC LOCAL GAIN BFO LIMITER BANDWIDTH ANT. TRIM AUTOTUNE AUDIO RESPONSE LINE GAIN LINE METER BREAK IN	OFF MED 5 OFF OFF 4 KC 0 REMOTE MED 5 0 ON
Selector Control C–974/FRR–33	BAY PREFIX SELECTOR OFF–REMOTE–LOCAL INT–EXT[a]	Authorized prefix OFF INT
Receiver Control C–975/URR	OFF–BFO–AFC	OFF
Power Supply PP–629/URR	ON–OFF	OFF
Remote Switching Control C–973/FRR–33	OFF–STDBY–ON TONE INT–EXT[a]	OFF INT

[a] Located on rear of unit.

(2) Place the OFF-LOCAL-REMOTE switch on Selector Control C–974/FRR–33 in LOCAL position.
(3) Select the desired pair of antennas. This can be accomplished by two methods as follows:
(*a*) Place the OFF-REMOTE-ANT 1-ANT 2 switch on the antenna coupler in REMOTE position and select the antennas by operation of the selector control dial.
(*b*) Place the OFF-REMOTE-ANT 1-ANT 2 switch in either ANT 1 or ANT 2 position.
(4) Dial the desired channel.

b. Remote Operation.
(1) Follow the information in paragraphs 39 and 40 in starting the equipment.
(2) Place the OFF-LOCAL-REMOTE switch on the selector control in REMOTE position.
(3) Place the OFF-REMOTE-ANT 1-ANT 2 switch on the antenna coupler in REMOTE position.
(4) Place the BAY PREFIX SELECTOR control on the selector control in the proper position.
(5) Place OFF-STDBY-ON switch on the remote switching control to ON.
(6) The equipment is then controlled by operation of the dial on Remote Switching Control C–973/FRR–33.

Note. If the stepping relay on the selector control doesn't follow each dial pulse, reset the ADJUST SENSITIVITY control on the selector control to minimum necessary for consistent operation.

43. Manual Operation

In some cases under extreme static or noise, or where Autotune power has failed, it may be desirable to operate the equipment manually.

a. Follow the information given in paragraphs 39 and 40 in starting the equipment.

b. Turn the ON-OFF switch on the power supply to OFF.

c. Loosen the Autotune locking keys on the ANTENNA TUNING and TUNING RANGE controls on the antenna coupler and the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls on the radio receivers.

d. Set the tuning controls of the antenna coupler and the radio receivers to the teletypewriter signal for a peak reading on the CARRIER LEVEL meters.

e. Rotate the KILOCYCLE CHANGE control on each receiver to where the meter on the receiver control reads SET.

f. Adjust the ANTENNA TUNING control on the antenna coupler for a peak reading of the CARRIER LEVEL meter of each receiver. If the peak readings of the two meters do not occur at the same point of a particular setting of the ANTENNA TUNING control, estimate the average and use this.

g. Set the proper CHANNEL A and CHANNEL B ADJUST SENSITIVITY controls on the antenna coupler to give a +10 DB reading on each CARRIER LEVEL meter.

Note. The proper ADJUST SENSITIVITY control to be adjusted is that indicated by the CHANNEL indicator on the receivers.

h. When there is interference, Receiver Control C–975/URR will not operate properly. To operate the radio receiving set using the internal bfo of the radio receivers, use the following procedure:
(1) Set the OFF-BFO-AFC control to BFO (on the receiver control).
(2) Set the BFO switch (on the radio receivers) to ON.
(3) Set the BFO PITCH control (on the radio receivers) to 0.
(4) Adjust the KILOCYCLE CHANGE control (on each radio receiver) to where the two tones are the same. This is halfway between the *mark* and *space* frequencies.
(5) Tune the BFO PITCH control (normally clockwise) for a steady indication on the meter on the frequency indicator (in the radioteletype terminal equipment). (The proper setting of the BFO PITCH control should be just past 2.)

44. Selection of Receiver Bandwidth

Selection of proper receiver bandwidth will depend upon receiving conditions. Ideally, the smallest bandwidth should be used, but the ideal situation will seldom exist. The 2 and 4-KC positions will normally be used. If a clear, low-noise signal is being received the 4-KC position should be selected. This allows for maximum drift of the transmitter frequency. The 2-KC position should be used when a nominal amount of interference exists. This still will provide some margin for transmitter error. In cases of extreme interference the 1-KC position may be used but careful tuning is required. Do not use the 1-KC position unless all other means fail. When interference is being received the bfo of the receiver instead of the receiver control must be used. When receiving time division multiplex signals, the 4-KC bandwidth should be used. The correct selection of the re-

ceiver bandwidth becomes a matter of operator experience. The stability of the transmitter, noise conditions, types and intensity of interference, etc. all must be taken into account in making the proper selection.

45. Operating Notes and Precautions

a. When presetting or operating manually, rotate the KILOCYCLE CHANGE control slowly when tuning in a station. Rapid rotation of the control makes location of the desired station difficult. It is also possible to "pull out" of afc because of the length of the time constants in the receiver control.

b. When tuning in a station, be sure to tune the KILOCYCLE CHANGE control to SET (white mark) on the receiver control. This is chiefly a matter of experience. To determine audibly that the mark frequency has been selected by the afc system, use the following procedure:

(1) Tune in a radio teletype station (using 850 cps shift) that is sending mark and space signals. Press the AFC DISCHARGE switch of the proper channel. Release the switch and rotate the KILOCYCLE CHANGE control until the kilocycle correction meter indicates —.7KC (to the left of center). Listen to the audio notes. Under the above conditions, the receiver control has locked to the space frequency. This will result in printing errors.

(2) Without touching the AFC DISCHARGE control, rotate the KILOCYCLE CHANGE control until the needle indicates 1.0KC. Press the AFC DISCHARGE control and again listen to the audible notes. Under this condition, the receiver control is locked to the mark frequency and is functioning correctly.

c. When peaking the CARRIER LEVEL meter, place the AGC control in FAST position.

d. When using the AFC position of the OFF-BFO-AFC switch, set the BFO control to OFF. Sufficient bfo leakage may be present in the radio receiver to cause interference.

e. Depending upon the conditions of the telephone line from the remote control point, the ADJUST SENSITIVITY control on the selector control may be positioned too far clockwise. This is evidenced by the stepping relay pulsing once only when the remote dial is operated, instead of following each dial pulse. Sensitivity should be set to minimum necessary for consistent operation.

f. Be sure Receiver Control C–975/URR is not locked to the space frequency. This can be checked by listening to filters in the radio-teletype terminal equipment to see that mark and space frequencies are both present (par. 35*p*).

g. Do not set CHANNEL A and B ADJUST SENSITIVITY controls in the antenna coupler higher than necessary or rf overloading may occur.

h. Under certain operating conditions, which are best determined by the skill and experience of the operator, it may be desirable to connect the agc line of the two radio receivers together. The receiver with the better signal then will develop more agc voltage than the other receiver, lowering the gain of the second receiver. This results in a signal with a better signal-to-noise ratio. Otherwise, signals with low signal-to-noise ratio result in poor operation, since the noise is amplified to the same extent as the signal, giving increased interference. Refer to paragraph 21 for the connections that must be made in this case.

i. In order to prevent the receiver control from locking to a weak off channel signal that may result when the radio receiving set and distant transmitter are tuned to a new channel, it is desirable to dial 06 (STANDBY) before dialing a new channel. The equipment may be dialed 05 (ON) when the transmitter has had sufficient time to reach the new channel.

46. Antijamming Instructions

When an operator recognizes that his receiving set is being jammed, he promptly will inform his immediate superior officer of this fact. Under no conditions will he cease operating. To provide maximum intelligibility of jammed signals, he will adhere to the operational procedure indicated in the following subparagraphs:

a. Operate the receiving set as outlined in paragraph 43.

b. Adjust the ANT. TRIM control on the radio receiver for maximum readable output signal.

c. If the noise is severe, adjust the LIMITER control as required.

d. Turn the CHANNEL A and B ADJUST SENSITIVITY controls on the antenna coupler of the channel selected for the best signal reception.

e. If these steps do not provide some degree of signal separation request a change in frequency and call sign.

f. If the jamming action is such that communication is impossible, report this fact to your immediate superior. Continue to operate.

47. Stopping Procedure

a. Stand-by Position. If it is desirable to place the equipment in a stand-by condition, either STANDBY or DISABLE functions may be dialed. In the STANDBY

condition, plate voltage is removed from the cathode followers in the antenna coupler, the break-in relay circuits of the radio receivers are closed, and the radioteletype terminal equipment is disabled. In the DISABLE condition the radio receiving set remains operative, but the radioteletype terminal equipment is disabled.

b. Stop position. To stop the equipment, do the following:

(1) Turn the OFF-STDBY-ON switch on the remote switching control to OFF.

(2) Turn the ON-OFF switch on the power supply to OFF.

(3) Turn the OFF-BFO-AFC switch on the receiver control to OFF.

(4) Turn the OFF-REMOTE-LOCAL switch on the selector control to OFF.

(5) Turn the FUNCTION switch on the radio receivers to OFF.

(6) Turn the OFF-REMOTE-ANT 1-ANT 2 switch on the antenna coupler to OFF.

(7) Turn the main power switch on cabinet (bottom rear) to OFF.

Section V. OPERATION UNDER UNUSUAL CONDITIONS

48. General

The operation of Radio Receiving Set AN/FRR–33 may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In the following paragraphs instructions are given on procedures for minimizing the effect of these unusual operating conditions.

49. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. When equipment which has been exposed to the cold is brought into a warm room, it will start to sweat and will continue to do so until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly. This condition also exists when equipment warms up during the day after exposure during a cold night.

50. Operation in Tropical Climates

When operated in tropical climates, radio equipment may be installed in tents or huts. When equipment is installed in swampy areas, moisture conditions are more acute than normal in the tropics. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the surrounding air. When this occurs, dry the equipment thoroughly before the equipment is turned on.

51. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measures to insure proper operation of the equipment. When additional ventilation for the equipment is needed, remove the black panels on the cabinet and the dust covers of the individual components.

b. The main problem which arises with equipment operation in desert areas is the large amount of sand or dust which enters the moving parts of radio equipment. The ideal preventive measure is to house the equipment in a dustproof shelter. Since, however, such a building is seldom available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and secure the side walls of tents with sand to prevent their flapping in the wind.

c. Never tie power cords, signal cords, or other wiring connections to any part of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

d. Be careful to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (ch. 3). Pay particular attention to the condition of the lubrication of the equipment. Excessive amounts of dust, sand, or dirt that come into contact with oil result in grit that will damage the equipment.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

52. Tools and Materials Supplied

No tools and materials are furnished as part of Radio Receiving Set AN/FRR–33. Special tools located on the rear of each radio receiver are furnished with each receiver. Refer to the instruction book covering Radio Receiver R–391/URR.

53. Tools, Materials, and Test Equipment Required

The following tools and materials are required for organizational maintenance procedures.

a. Tools.
Tool Equipment TE–41.

b. Materials.
Cheesecloth, bleached, lint-free.
Paper, sand, flint #0000.
Solvent, Dry-Cleaning (SD) (Fed. spec. No. P–S–661a)

c. Test Equipment.
Electronic Multimeter TS–505/U.

Section II. PREVENTIVE MAINTENANCE SERVICES

54. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdown and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring. Refer to AR 750–5, Maintenance of Supplies and Equipment, Maintenance Responsibilities and Shop Operation.

55. General Preventive Maintenance Techniques

a. Use #0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent, Dry Cleaning (SD); then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a cloth.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

c. If available, dry compressed air may be used at a line pressure not exceeding 35 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178, Preventive Maintenance Guide for Radio Communication Equipment.

56. Use of Preventive Maintenance Forms (figs. 50 and 51)

a. The decision as to which items on DA Forms 11–238 and –239 are applicable to this equipment is a decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Circled items in figures 50 and 51 are partially or totally applicable to Radio Receiving Set AN/FRR–33. References in the ITEM block refer to paragraphs in the text which contain additional maintenance information.

57. Performing Preventive Maintenance

a. Performing Exterior Preventive Maintenance.

Caution: Tighten screws, bolts, and nuts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

(1) Check for completeness and satisfactory condition of the radio receiving set. The com-

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; Ⓧ Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* PAR. 57 a (1)							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR. 57 a (2)							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE. HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 57 a (3)							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 57 a (4)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 57 a (5)							
6	CHECK FOR NORMAL OPERATION. PAR. 57 a (6)							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR. 57 a (7)		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 57 a (8)		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR. 57 a (12)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 57 a (9)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 57 a (13)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS. PAR. 57 a (10)		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING. PAR. 57 a (14)	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION. PAR. 57 a (15)	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 57 a (11)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. PAR. 57 a (16)

DA FORM 1 MAY 51 11-238 REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

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Figure 50. DA Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE | EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; ① Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	COND.	NO.	ITEM	COND.
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories*). PAR. 57 a (1)		19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS; INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. PAR. 57 b (1)	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR. 57 a (2)		20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 57 a (3)		21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR. 57 b (2)	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 57 a (4)		22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS. PAR. 57 b (3)	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 57 a (5)		23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS. PAR. 57 b (4)	
6	CHECK FOR NORMAL OPERATION. PAR. 57 a (6)		24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR. 57 b (5)	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR. 57 a (7)		25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. PAR. 57 b (6)	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 57 a (8)		26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR. 57 b (7)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 57 a (9)		27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS. PAR. 57 b (8)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS. PAR. 57 a (10)		28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER. PAR. 57 b (9)	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 57 a (11)		30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.		31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS. PAR. 57 b (10)	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR. 57 a (12)		32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR. 57 b (11)	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 57 a (13)		33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING. PAR. 57 a (14)		34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION. PAR. 57 a (15)		35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.		36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
			37	MOISTURE AND FUNGIPROOF. PAR. 57 b (12)	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. PAR. 57 b (13)				

DA FORM 1 MAY 51 11-239 REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 40—10—44303-1

TM 871-51

Figure 51. DA Form 11-239.

ponents are listed in paragraph 7.

(2) Check suitability of location and installation for normal operation (par. 18).

(3) Remove dirt and moisture from connectors and component panels (par. 55).

(4) Inspect the seating of fuses and connectors on the rear of each component (figs. 3, 8, 10, 12, 14, 16, 18, and 36).

(5) Check the controls for binding, scraping, and excessive looseness (figs. 38 and 49).

(6) Check the radio receiving set for normal operation. If abnormal results occur at any point in the operating procedure, refer to the equipment performance checklist (par. 59).

(7) Clean and tighten the cables and connectors of all the components in the system (fig. 36).

(8) Inspect the cabinet, component chassis, and exposed metal parts for rust, corrosion, and moisture (par. 64).

(9) Inspect cables for cuts, breaks, fraying, deterioration, kinks, and strain (fig. 36).

(10) Inspect the antenna installations for looseness, corrosion, and damaged insulators (par. 21*c*.).

(11) Inspect for looseness: switches, knobs, indicator lamp assemblies, and meters (fig. 1).

(12) Clean all nameplates, caution plates, meter faces, and indicator lamp jewels (par. 55).

(13) Inspect all meter glasses and cases for possible damage (fig. 1).

(14) Inspect the operating shelter for adequacy of weatherproofing (par. 63).

(15) Inspect antenna guy wires for looseness and proper tension (par. 21*c*.).

(16) If deficiencies noted are not corrected during inspection, indicate action taken for correction.

b. Performing Interior Preventive Maintenance.

Caution: Disconnect all power before performing the ollowing operations. Upon completion, reconnect power nd check for satisfactory operation.

Note. Refer to the interior preventive maintenance checks in the instruction books covering Radio Receiver R-391/URR and Receiver Control C-975/URR for additional information.

(1) Inspect electron tubes for loose envelopes and cracked sockets; check for insufficient socket spring tension; remove dirt and dust carefully; check emission of receiver type tubes (figs. 30 and 35).

(2) Inspect fixed capacitors for leaks, bulges, and discoloration (figs. 97 through 103).

(3) Inspect relay assemblies for loose mounting; inspect relay K1402 for faulty contacts (figs. 97 through 103).

(4) Inspect variable capacitors for dirt, moisture, misalinement of plates, and loose mountings.

(5) Inspect resistors and insulators for cracks, chipping, blistering, discoloration, and moisture.

(6) Inspect terminals of large fixed capacitors and resistors for corrosion, dirt and loose connections.

(7) Clean and tighten switches, terminal boards, relay cases, and interiors of chassis and cabinet not readily accessible (par. 55).

(8) Inspect terminal blocks for loose connections, cracks, and breaks (fig. 3).

(9) Lubricate the equipment in accordance with instructions given in paragraphs 58 through 60.

(10) Clean and tighten mountings of all transformers and potentiometers.

(11) Inspect power transformers for overheating and leakage (par. 66).

(12) Check adequacy of moistureproofing and fungiproofing treatment (par. 63).

(13) If deficiencies noted are not corrected during inspection, indicate what action was taken to correct them.

Section III. LUBRICATION

58. General

a. The type of lubricant to be used, the interval, and specific instructions for each part are given in figures 52 through 57.

b. Gasoline will not be used as a cleaning fluid for any purpose. When a unit is overhauled or repairs are made, parts should be cleaned with solvent (SD).

c. Carbon tetrachloride will be used as a cleaning fluid only in the following cases: on electrical equipment where inflammable solvents cannot be used because of fire hazard, and for cleaning relay contacts, plugs, etc.

d. Intervals given are for normal eight-hour day operation. For abnormal conditions or activities, intervals should be shortened.

e. For lubrication instructions on Radio Receiver R–391/URR refer to the instruction book covering the receiver.

f. No lubrication is to be performed at organizational level.

59. Lubrication of Antenna Coupler CU–286/FRR–33

Remove the front panel according to instructions given in paragraph 117. Remove the two Autotune positioning heads and Autotune control head from the Autotune casting assembly (fig. 74) by removing the three screws holding each unit in place. Lubricate each positioning head according to instructions given in figure 52. Lubrication of the Autotune control head is indicated in figure 53. Lubrication of the Autotune casting assembly is given in figure 54.

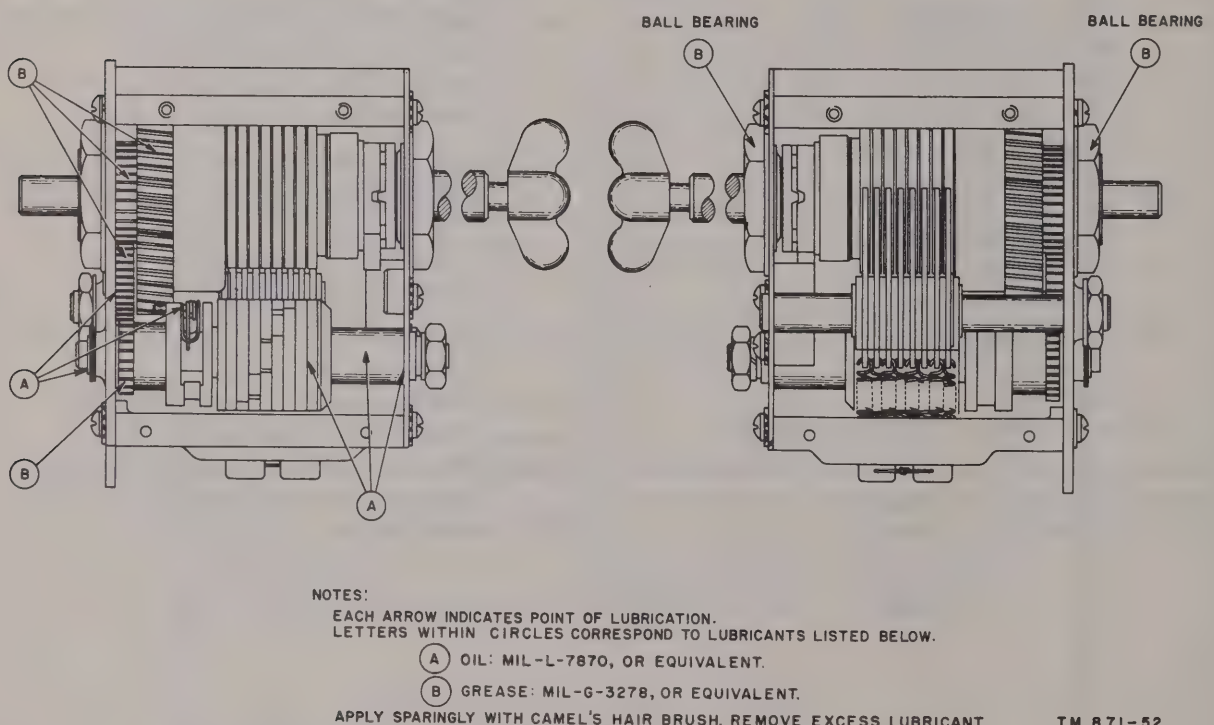
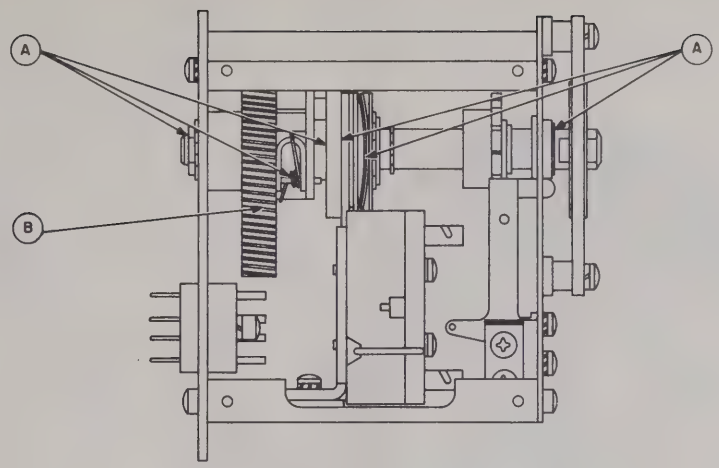


Figure 52. Antenna Coupler CU-286/FRR-33, Autotune positioning head, lubrication diagram.



NOTE:
EACH ARROW INDICATES A POINT OF LUBRICATION.
LETTERS WITH CIRCLES CORRESPOND TO LUBRICANTS LISTED BELOW:
(A) OIL: MIL-L-7870, OR EQUIVALENT.
(B) GREASE: MIL-G-3275, OR EQUIVALENT.
APPLY SPARINGLY WITH CAMEL'S HAIR BRUSH. REMOVE EXCESS LUBRICANT.

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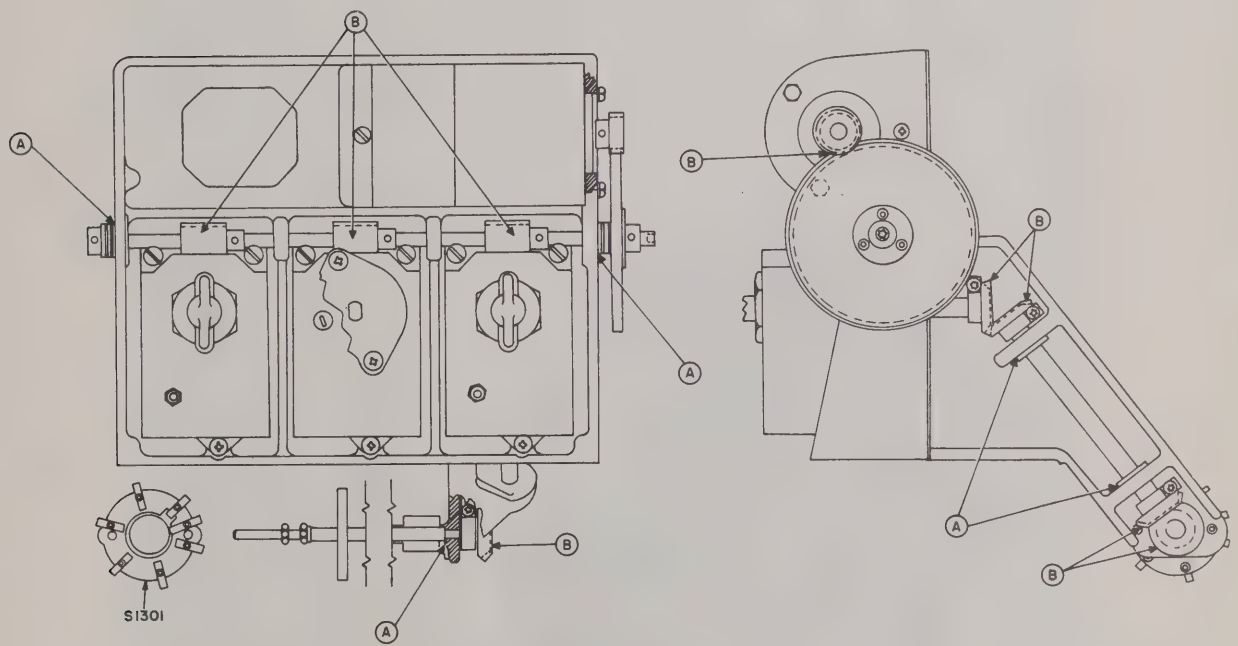
Figure 53. Antenna Coupler CU-286/FRR-33, Autotune control head, lubrication diagram.



LUBRICANTS

(A) OIL: MIL-L-644A, OR EQUIVALENT

(B) GREASE: MIL-G-3278, OR EQUIVALENT

DIRECTIONS

OIL ALL SHAFT BEARINGS EVERY SIX MONTHS.

APPLY A THIN COATING OF GREASE TO ALL GEARS EVERY SIX MONTHS.

TM 871-54

Figure 54. Antenna Coupler CU-286/FRR-33, Autotune casting assembly, lubrication diagram.

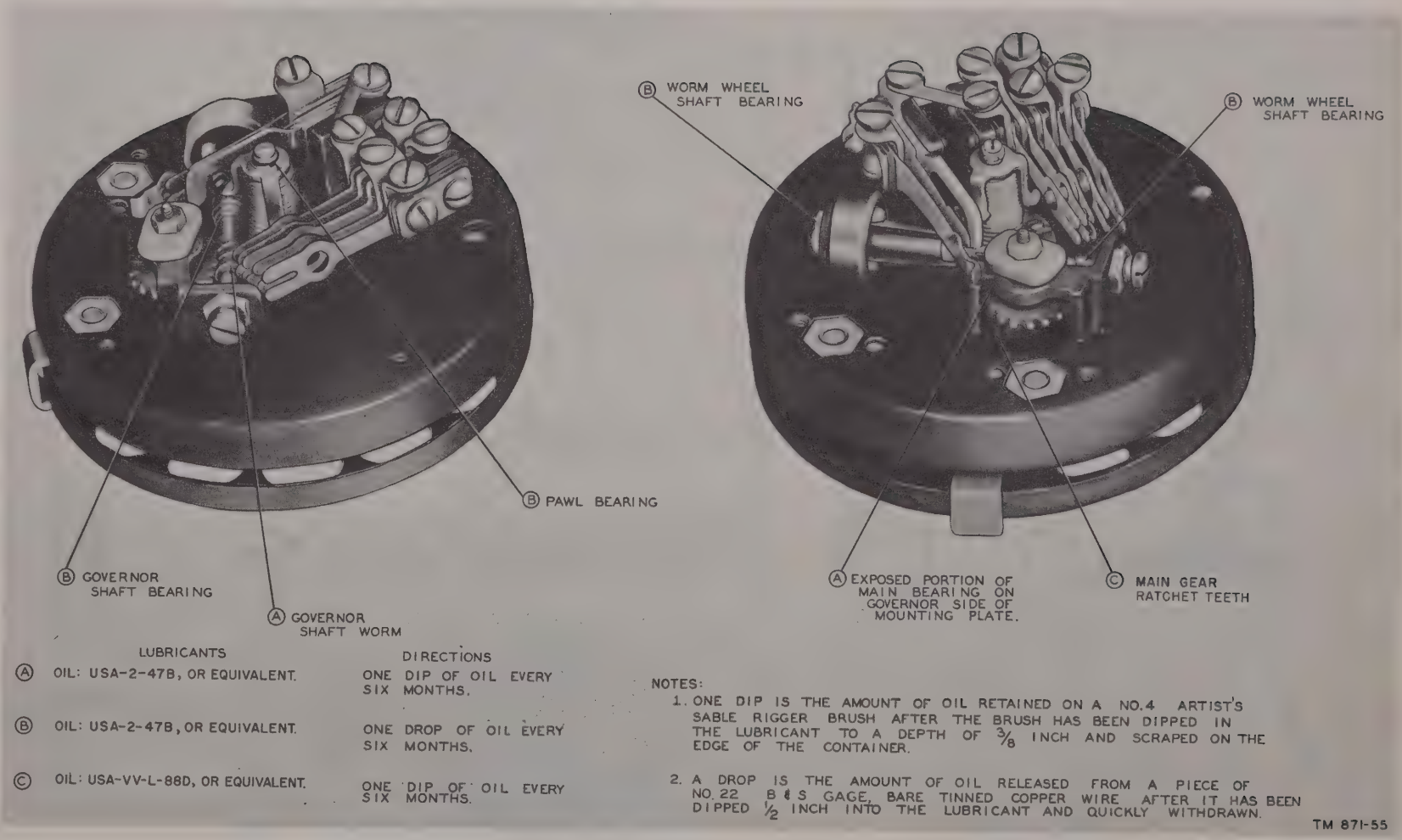

Ⓑ WORM WHEEL SHAFT BEARING
Ⓑ WORM WHEEL SHAFT BEARING
Ⓑ PAWL BEARING
Ⓑ GOVERNOR SHAFT BEARING
Ⓐ GOVERNOR SHAFT WORM
Ⓐ EXPOSED PORTION OF MAIN BEARING ON GOVERNOR SIDE OF MOUNTING PLATE.
Ⓒ MAIN GEAR RATCHET TEETH
LUBRICANTS
DIRECTIONS
Ⓐ OIL: USA-2-47B, OR EQUIVALENT. ONE DIP OF OIL EVERY SIX MONTHS.
Ⓑ OIL: USA-2-47B, OR EQUIVALENT. ONE DROP OF OIL EVERY SIX MONTHS.
Ⓒ OIL: USA-VV-L-88D, OR EQUIVALENT. ONE DIP OF OIL EVERY SIX MONTHS.
NOTES:
1. ONE DIP IS THE AMOUNT OF OIL RETAINED ON A NO.4 ARTIST'S SABLE RIGGER BRUSH AFTER THE BRUSH HAS BEEN DIPPED IN THE LUBRICANT TO A DEPTH OF 3/8 INCH AND SCRAPED ON THE EDGE OF THE CONTAINER.
2. A DROP IS THE AMOUNT OF OIL RELEASED FROM A PIECE OF NO. 22 B & S GAGE, BARE TINNED COPPER WIRE AFTER IT HAS BEEN DIPPED 1/2 INCH INTO THE LUBRICANT AND QUICKLY WITHDRAWN.
TM 871-55

Figure 55. Selector Control C-974/FRR-33, dial assembly, lubrication diagram.

60. Lubrication of Selector Control C–974/FRR–33

Instructions for lubricating the selector control are given in figures 55, 56, and 57. Figure 55 includes instructions for lubricating dial S1403; figure 56 contains lubrication instructions for stepping relay K1402; and figure 57 includes directions for lubricating the Autopositioner unit.

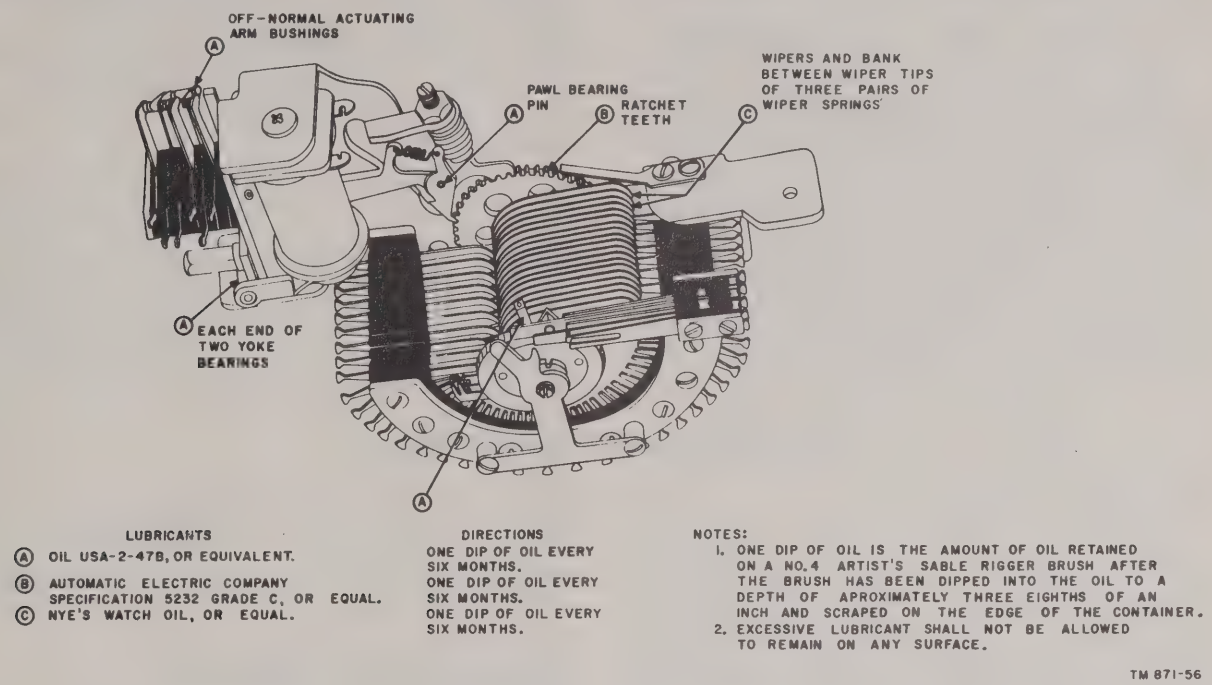

OFF-NORMAL ACTUATING ARM BUSHINGS
A
PAWL BEARING PIN
A
RATCHET TEETH
B
WIPERS AND BANK BETWEEN WIPER TIPS OF THREE PAIRS OF WIPER SPRINGS
C
A
EACH END OF TWO YOKE BEARINGS
A
LUBRICANTS
A OIL USA-2-47B, OR EQUIVALENT.
B AUTOMATIC ELECTRIC COMPANY SPECIFICATION 5232 GRADE C, OR EQUAL.
C NYE'S WATCH OIL, OR EQUAL.
DIRECTIONS
ONE DIP OF OIL EVERY SIX MONTHS.
ONE DIP OF OIL EVERY SIX MONTHS.
ONE DIP OF OIL EVERY SIX MONTHS.
NOTES:
1. ONE DIP OF OIL IS THE AMOUNT OF OIL RETAINED ON A NO.4 ARTIST'S SABLE RIGGER BRUSH AFTER THE BRUSH HAS BEEN DIPPED INTO THE OIL TO A DEPTH OF APROXIMATELY THREE EIGHTHS OF AN INCH AND SCRAPED ON THE EDGE OF THE CONTAINER.
2. EXCESSIVE LUBRICANT SHALL NOT BE ALLOWED TO REMAIN ON ANY SURFACE.
TM 871-56

Figure 56. Selector Control C-974/FRR-33, stepping relay, lubrication diagram.

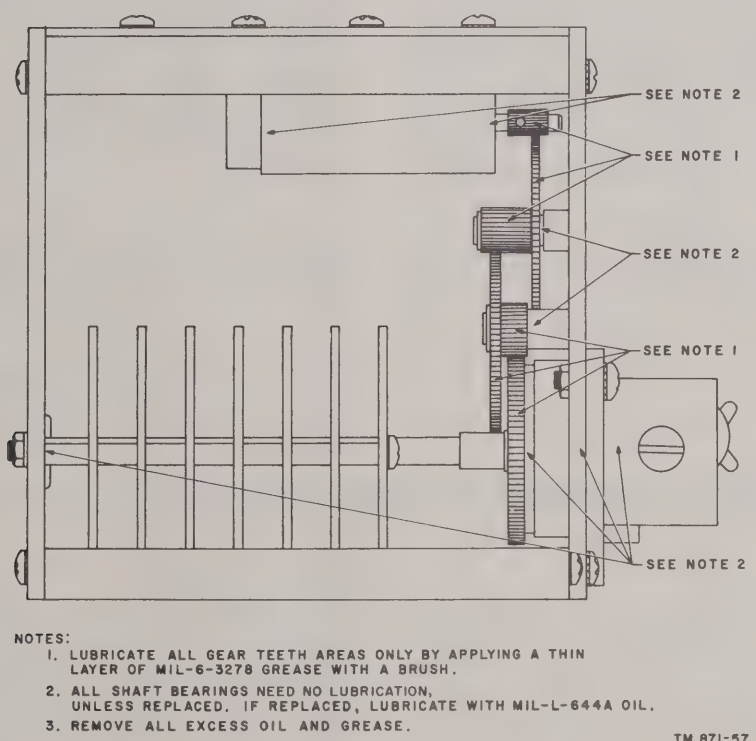

SEE NOTE 2
SEE NOTE 1
SEE NOTE 2
SEE NOTE 1
SEE NOTE 2
NOTES:
1. LUBRICATE ALL GEAR TEETH AREAS ONLY BY APPLYING A THIN LAYER OF MIL-6-3278 GREASE WITH A BRUSH.
2. ALL SHAFT BEARINGS NEED NO LUBRICATION, UNLESS REPLACED. IF REPLACED, LUBRICATE WITH MIL-L-644A OIL.
3. REMOVE ALL EXCESS OIL AND GREASE.
TM 871-57

Figure 57. Selector Control C-974/FRR-33, Autopositioner unit, lubrication diagram.

61. Lubrication of Remote Switching Control C–973/FRR–33

The only points of lubrication in the remote switching control are located in dial S1201. Instructions for lubricating the dial are given in figure 55.

62. Lubrication under Unusual Conditions

a. Arctic Regions. Lubricants which are satisfactory at moderate temperatures stiffen and solidify at subzero temperatures; as a result moving parts bind or become inoperative. Consult the key on a lubrication order for the proper grade of lubricant for operating the equipment in arctic regions. When preparing the equipment for low-temperature operation, see that lubricants used for moderate temperatures are thoroughly removed. Even small amounts of such lubricants, if allowed to remain, may impair the operation of moving parts. Be sure to use the lubricant specified for low-temperature operation.

b. Tropical Regions. High temperatures and moisture due to rain, condensation, etc., may cause lubricants which are normally satisfactory to flow from moving parts and other surfaces. These bearing surfaces will wear excessively, and hinges, fasteners, and other parts will be damaged or destroyed by rust or corrosion. Inspect the equipment daily and lubricate it as required to insure efficient operation, using lubricants suitable for high temperatures.

c. Desert Regions. Dust and sand infiltration into the equipment causes grit in the lubricants and will seriously impair and damage the moving parts of the set. Hot dry temperatures cause the lubricants to flow from the moving parts, and conditions similar to those described in subparagraph *b* above will result. Use lubricants suitable for high temperatures. Inspect and clean the equipment daily.

Section IV. WEATHERPROOFING

63. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is fully explained in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment and TB SIG 72, Tropical Maintenance of Ground Signal Equipment.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are fully explained in TB SIG 66, Winter Maintenance of Signal Equipment and TB SIG 219, Operation of Signal Equipment at Low Temperatures.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subjected to extremely high temperatures, low humidity, and excessive sand and dust are fully explained in TB SIG 75, Desert Maintenance of Ground Signal Equipment.

64. Rustproofing and Painting

a. When the finish on a component or the cabinet has been badly scarred or damaged, rust or corrosion can be prevented by touching up bared surfaces. Use #00 or #000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, remove loose paint and apply paint with a small brush. Remove rust from the case by cleaning corroded metal with a solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section V. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

65. General

a. The trouble-shooting and repair work that can be performed at the organizational level (operators and repairmen) is necessarily limited in scope by the tools, test equipment, and replaceable parts issued. Accordingly, trouble shooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes, cracked insulators, etc.

b. The following paragraphs in this section will help to determine which of the components, such as the antenna coupler, receivers, receiver control, etc., are at fault and will aid in localizing the fault in that component to the defective stage or item, such as a tube or fuse.

66. Visual Inspection

a. Failure of the equipment to operate properly usually will be caused by one or more of the following faults:

(1) Burned-out fuse.
(2) Defective tube.
(3) Worn, broken, or disconnected cables.
(4) Loose connections.
(5) Bad (dirty or broken) switch contacts.
(6) Line voltage low or not applied.
(7) Defective receivers.
(8) Grounded or broken antenna or antenna lead-in.

b. When failure is encountered and the cause is not immediately apparent, check as many of the above items as practicable before starting a detailed examination of the component parts of the system. If possible, obtain information from the operator of the equipment regarding performance at the time trouble occurred.

67. System Sectionalization of Trouble to a Component

System sectionalization consists of determining whether the trouble is in one of the two receivers used in the radio receiving set or in one of the other components, or whether the trouble is external to the radio receiving set.

a. Operate the set and observe performance. Refer to the equipment performance checklist (par. 69) for normal operating indications. Over-all operation can be partially checked by meter readings.

b. If the entire set is dead, the trouble is probably in the power source or power connection.

c. If only one component is dead, the trouble is in that component.

d. If the equipment can be operated from a local position but not from a remote position, the Remote Switching Control C–973/FRR–33, the connecting line, or the input stage of Selector Control C–974/FRR–33 is at fault.

e. For complete information on Radio Receiver R–391/URR and on Receiver Control C–975/URR refer to the instruction books covering the receiver and receiver control.

68. Trouble Shooting by Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 69) will help the repairman locate trouble in the radio receiving set. The checklist gives the items to be checked, the conditions under which the item is checked, the normal indications of correct operation, and the corrective measures to be taken. *To use this list, follow the items in numerical sequence.*

b. Action or condition. For some items, the information given in the *action or condition* column consists of the settings of various switches and controls under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the *normal indication* column.

c. Normal indications. The normal indications listed include the visible and audible signs that the repairman should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective measures. The corrective measures listed are those the operator or repairman can make without turning in the equipment for repairs. A reference to a paragraph indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is called for. If the tactical situation requires that communication be maintained, and the equipment is not completely inoperative, the operator must maintain it in operation as long as possible.

69. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Cording	All cords and cables in correct position and plugs secure in jacks (fig. 36).		
	2	Antennas	Lead-in wires connected.		
	3	Telephone line to remote control position.	Line connected properly.		
	4	600-ohm line to radioteletype terminal equipment.	Connected to proper terminals on each receiver.		
	5	Antenna coupler function switch.	Set to OFF.		

69. Equipment Performance Checklist (cont)

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	6	Radio receiver FUNCTION switch.	Set to OFF.		
	7	AGC switch.	Set to MED.		
	8	LOCAL GAIN control.	Set to 5.		
	9	BFO control.	Set to OFF.		
	10	LIMITER control.	Set to OFF.		
	11	BANDWIDTH.	Set to 4 KC.		
	12	ANT. TRIM control.	Set to 0.		
	13	AUTOTUNE switch.	Set to REMOTE.		
	14	AUDIO RESPONSE control.	Set to MED.		
	15	LINE GAIN control.	Set to 5.		
	16	LINE METER switch.	Set to 0.		
	17	BREAK IN switch.	Set to ON.		
	18	Selector control OFF–REMOTE–LOCAL switch.	Set to OFF.		
	19	BAY PREFIX SELECTOR switch.	Set to authorized position.		
	20	Selector control INT–EXT switch (on rear panel).	Set to INT.		
	21	Receiver control OFF–BFO–AFC switch.	Set to OFF.		
	22	METER switch.	Set to OFF.		
	23	Power supply OFF–ON switch.	Set to OFF.		
	24	Remote switching control OFF–STDBY–ON switch.	Set to OFF.		
	25	INT EXT TONE switch (on rear panel).	Set to INT.		
	26	Antenna coupler function switch.	Set to REMOTE.	Dial lamp I 1301 lights.	Check FUSE 2.0A on rear panel. Check power source and cable (par. 21). Replace lamp (fig. 97). Refer to paragraph 110*b*.
START	27	Radio receiver FUNCTION switch.	Set to AGC.	Dial lamps light.	Check Fuse AC 3A on rear panel. Check power cable (par. 21). Check dial lamp. Refer to the instruction book covering the radio receiver.
	28	Receiver control OFF–BFO–AFC switch.	Set to AFC.	Tube filaments heat up.	Check Fuse F1501 3 AMP. Check power cable. Refer to the instruction book covering the receiver control.
	29	Power supply ON–OFF switch.	Set to ON.	Lamp I 1101 will light.	Check FUSES 10 AMP F1101 and F1102 on rear panel. Check power cable (par. 21). Replace lamp. Refer to paragraph 110*d*.
	30	Remote switching control OFF–STDBY–ON switch.	Set to ON.	POWER lamp lights.	Check FUSE F1201 1.0A on rear panel. Check power cable (par. 21). Replace lamp. Refer to paragraph 110*e*.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	31	Selector control dial.	Set OFF–REMOTE–LOCAL switch to LOCAL. Dial ANT. 1 or ANT. 2.	ANT. 1 or ANT. 2 indicator lamp lights.	Replace lamp (fig. 42). Refer to paragraph 110*c*.
			Dial desired channel.	CHANNEL indicator lamp lights.	Replace lamp. Refer to paragraph 110*c*.
				Autotunes set up.	Refer to paragraph 111.
				Signals received.	Sectionalize trouble to a particular unit or channel by replacing a known good component with each unit in turn. Refer to paragraph 110 or the instruction book covering the unit.
				CARRIER LEVEL meters show strength of signals.	
				Audio signal in headsets.	Refer to the instruction book covering the radio receiver.
	32	Remote switching control dial.	Set OFF–REMOTE–LOCAL switch (on selector control) to REMOTE. Dial desired channel.	TUNING IN PROGRESS lamp lights during tuning.	Replace lamp. Refer to paragraph 110.
				CHANNEL indicator lamp lights.	Check LOCAL operation of same channel (step 31 above). Refer to paragraph 110.
	33	Radio receiver controls.	Refer to the instruction book covering the radio receiver.		
	34	CHANNEL A and B ADJUST SENSITIVITY control on antenna coupler.	Rotate controls for selected channel.	Indicator lamp goes out at counter clockwise position and lights as control is turned clockwise.	Refer to paragraph 110.
	35	ADJUST SENSITIVITY control on selector control.	Rotate control.	Tone impulse amplitude increases as control is turned clockwise. Amplitude at maximum clockwise position may overload selector control; if so, selector control will not follow tone impulses correctly.	Refer to paragraph 110.
STOP	36	Main power switch on cabinet.	Set to OFF.		
	37	Remote switching control OFF–STDBY–ON switch.	Set to OFF.		
	38	Power supply ON–OFF switch.	Set to OFF.		
	39	Receiver control OFF–BFO–AFC switch.	Set to OFF.		
	40	Selection control OFF–REMOTE–LOCAL switch.	Set to OFF.		
	41	Radio receiver FUNCTION switch.	Set to OFF.		
	42	Antenna coupler function switch.	Set to OFF.		

CHAPTER 4
SYSTEM THEORY

Section I. DIVERSITY RECEPTION

70. General

Diversity reception is the name given to a system of radio reception in which a minimum of two receivers with separate antennas are used to minimize the effects of fading. Both receivers are tuned to the same frequency and receive the same signal. The outputs of the two receivers are applied to radioteletype terminal equipment which provides diversity combining to insure the best possible reception. The output of the terminal equipment is fed to the teletypewriter.

71. Explanation of Fading

The term fading, as discussed in connection with diversity reception, is used to denote variations in signal strength over periods of a fraction of a second to several minutes duration. The term does not refer to the slow, hour-to-hour, day-to-night, day-to-day, or seasonal variations in signal strength. It is generally agreed that signal fading is caused by the fact that radio waves propagated from a transmitter may travel over two or more paths between the transmitting and receiving antennas. Differences in the lengths of these paths cause the several signals arriving at a receiving antenna to have varied phase relationships. These variations in phase frequently result in either complete or partial addition or cancellation of the signal potential. The distance traveled by the signal is controlled principally by three factors: distance between transmitting and receiving antennas; frequency of the transmitted signal; and instantaneous height of the ionosphere above the surface of the earth. The first two factors are constant for a given signal, but the third is variable with continuously changing ionospheric conditions.

72. Elimination of Fading

In the diversity system of reception the receiving antennas are spaced several wavelengths apart. This makes it extremely unlikely for cancellation of the received signal to occur in both antennas at the same instant. One antenna or the other, therefore, generally will have a sufficiently strong signal to operate the radio receiving set. The signal from each antenna is fed to a separate receiver, and the detected outputs of the receivers are applied to Radioteletype Terminal Equipment AN/FGC–1. The terminal equipment diversity combines the two signals and uses it to operate the automatic printing equipment associated with the system. The final output of the system is derived from the voltage induced on one antenna only, although the selection of separate antennas may change quickly with conditions of fading.

Section II. SYSTEM OPERATION

73. General

Figure 59 is a block diagram of a radioteletype system in which Radio Receiving Set AN/FRR–33 is used with Radioteletype Terminal Equipment AN/FGC–1( ). In figure 59 a complete operating loop is indicated al-

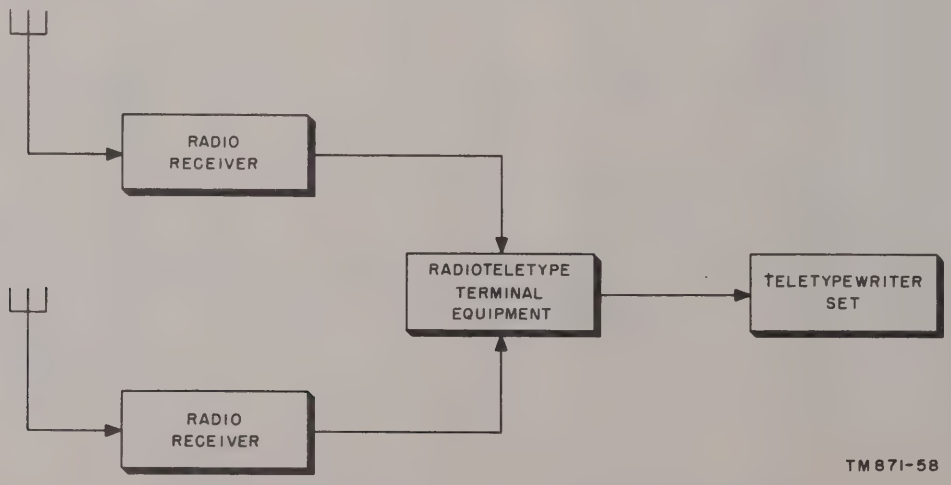


Figure 58. Diversity receiving system, simplified block diagram.

though either station may be part of several such systems. The radio transmitter sends out its normal frequency when the contacts of the telegraph-sending mechanism are closed (MARK condition), and when the contacts are opened (SPACE condition), the radio frequency carrier is reduced 850 cps, the amplitude remaining unchanged. These rf transmissions are picked up by the antennas of the radio receiving set and applied to channel A and channel B circuits. The various circuits in the radio receiving set function to give audio output signals of the proper frequency (2, 125 and 2,975 cps) to operate Radioteletype Terminal Equipment AN/FGC–1 ( ). The output signals, taken from the line audio outputs of Radio Receivers R–391/URR, are applied to the radioteletype terminal equipment, which provides diversity combining and produces direct-current pulses for operation of teletypewriter equipment. The dc pulses are controlled through the operation of the receive relay in the radioteletype terminal equipment.

74. Unit Block Diagram

The block diagram in figure 60 indicates the signal path of an individual radio receiving set. Signal voltage developed in one of the channel A antennas is fed to the antenna coupler. Output of the antenna coupler is applied to receiver A, where it is heterodyned to give a 455-kc signal. Under normal conditions the signal is now fed to the receiver control unit and mixed with the bfo to give an audio signal with automatic frequency control. If frequency control is not desired, however, the if. signal of the receiver may be mixed with the output of a bfo in the receiver. The audio signal is amplified in the receiver and applied to the radioteletype terminal equipment. Control circuits for local selection of the various channels and functions are located in the selector control component of the radio receiving set. The same selection is available from a remote position through the functioning of the remote switching control. Power for the motor-tuning circuits is obtained from a separate power supply unit mounted in the equipment rack, but plate and filament voltage for the components is obtained from individual power supplies located in each component. For a complete discussion on the individual units, refer to Chapter 5 and the instruction book covering the radio receiver and receiver control.

75. Control Circuits

a. General. The following subparagraphs discuss only those circuits which are completed through more than one unit of an individual radio receiving set. The circuits are described only in general detail. For specific operation of each circuit within an individual unit, refer to the section on unit theory.

b. Ac Power Distribution (fig. 61). 115/230-volt ac power is applied to the main ac switch. Protection for the power source is provided by 15-ampere fuses F1801 and

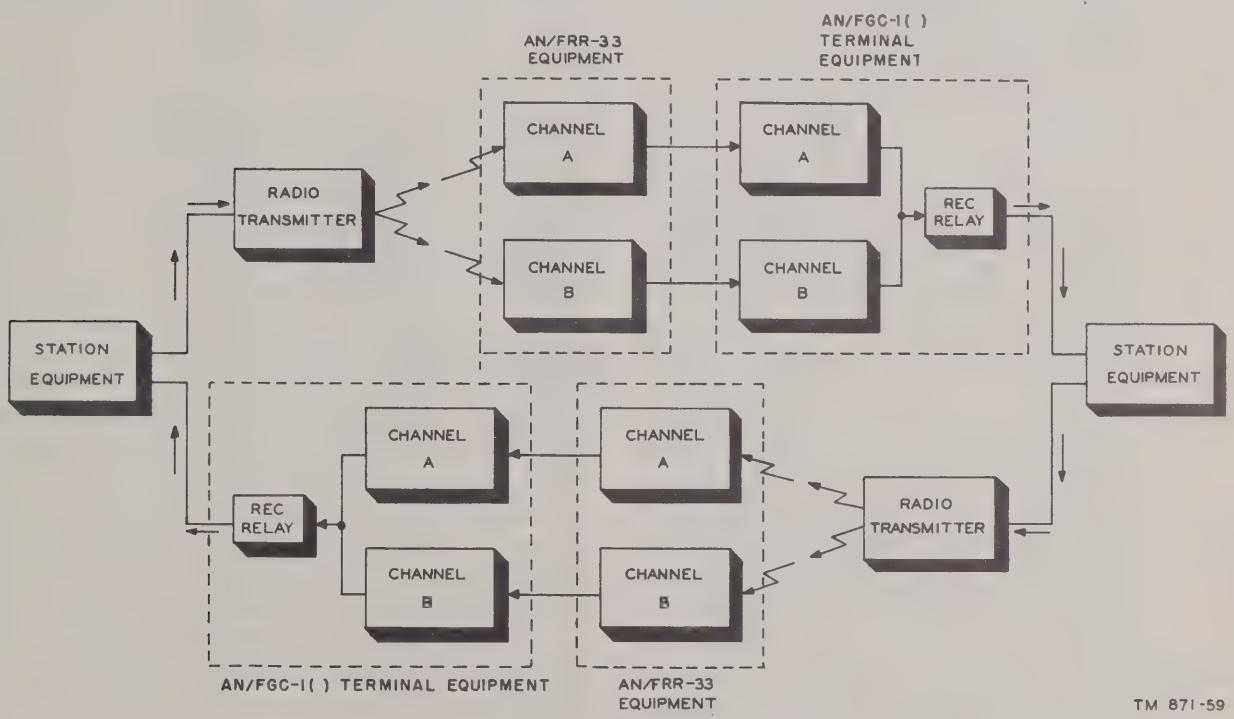


Figure 59. Two-way radioteletype system, block diagram.

F1802, located within the switch-box. Throwing the main switch to ON causes the following action:

(1) *Antenna Coupler CU–286/FRR–33.* Ac power is applied to power input receptacle J1342 through Power Cable Assembly CX–1358/U. The circuit is completed through contact D of receptacle J1342, fuse F1301, the primary of transformer T1314, 115/230-volt switch S1302, Section 1 of the OFF-REMOTE-ANT 1-ANT 2 switch, to contact A of receptacle J1342. The primary of relay power transformer T1314 is connected in parallel with the primary of transformer T1313.

(2) *Radio Receiver R–391/URR (receiver B).* Ac power is applied to receiver B through a circuit arrangement similar to that of the antenna coupler. The basic difference is the addition of a pi-type filter in each side of the ac input line. Power is supplied to the radio receiver through Power Cable Assembly CX–1358/U to POWER receptacle J104. The circuit is then completed from contact D of receptacle J104 through one section of line filter FL101, fuse F101, contacts 9 and 11 of jack and plug P118 and J818, section C of FUNCTION switch, contact 2 of jack and plug P118 and J818, primary of transformer T801, 115/230-volt switch S801, contact 1 of plug-and-jack P112 and J818, the other section of line filter FL101, to contact A of receptacle J104.

(3) *Radio Receiver R–391/URR (receiver A).* Ac power is applied to receiver A through a circuit identical to that of receiver B.

(4) *Receiver Control C–975/URR.* 115/230-volt power is applied to power input receptacle J1570 through Power Cable Assembly CX–1358/U. The circuit is then completed through contact D of receptacle J1570, fuse F1501, primary of power transformer T1509, 115/230-volt switch S1503, section 3 of OFF-BFO-AFC switch S1501, to contact A of receptacle J1570.

(5) *Power Supply PP–629/URR.* Ac power is supplied to the power supply through Power Cable Assembly CX–1358/U. The power input receptacle is J1131. The circuit is completed from contact D of receptacle J1131 through fuse F1101, primary of transformer T1101, 115/230-volt switch S1101, ON-OFF switch, fuse F1102, to contact A of receptacle J1131.

(6) *Selector Control C–974/FRR–33.* Contacts A and D of receptacle J1132 (located on Power Supply PP–629/URR) are connected in parallel with 115/230-volt contacts A and D of receptacle J1131. Ac voltage is then supplied to power input receptacle J1453 by means of Electrical Power Cable Assembly CX–2751/U, connected between receptacles J1132 and J1453. The circuit is then completed from contact D of receptacle J1453 through fuse F1401, primary of transformer T1402, 115/230-volt switch S1406, section 3 of OFF-REMOTE-LOCAL switch S1402, to contact A of receptacle J1453. The primary of relay power transformer T1403 is connected in parallel with the primary of power transformer T1402.

(7) *Radioteletype Terminal Equipment AN/FGC–1( ).* Contacts A and G of receptacle J1458 (located on the selector control) are connected in parallel with the primaries of transformers T1402 and T1403. Ac power is then taken from this receptacle by means of Electrical Power Cable Assembly CX–2755/U and applied to receptacle J1773 in the junction box (fig. 3). Receptacle J1773 is wired internally to receptacle J1775. The power cord supplied with the radioteletype terminal equipment plugs into receptacle J1775. Contacts A, B, and F of receptacle J1458 are connected to contacts of stand-by relay K1411. For a complete discussion of the stand-by circuit, see paragraph 91. Refer to TM 11–356 for information concerning ac distribution within the radioteletype terminal equipment.

c. Channel Selection (fig. 62). Selection of a channel is possible from either a local or remote position. In the local position operation of the dial on Selector Control C–974/FRR–33 controls channel selection. The dial on Remote Switching Control C–973/FRR–33 controls channel selection from a remote position. The diagram in figure 62 assumes the previous selection of channel 4. Refer to paragraphs 80 and 81 for a discussion of the circuits involved in this selection. Autopositioner motor B1401 drives section 1 of switch S1405 until channel 4 position is reached. The remaining switch sections complete circuits as shown in figure 62. Section 2 of switch S1405 completes the circuit for the CHANNEL indicating lamp. Section 3 provides a ground return for operation of the Autotune in the antenna coupler. Sections 4 and 5 connect the rf sensitivity controls (located in the antenna coupler) to the proper cathode returns in the two receivers. Sections 6 and 7 provide ground return circuits for the Autotunes in receiver B and receiver A. The Autotunes in the various units then operate to select channel 4 circuits.

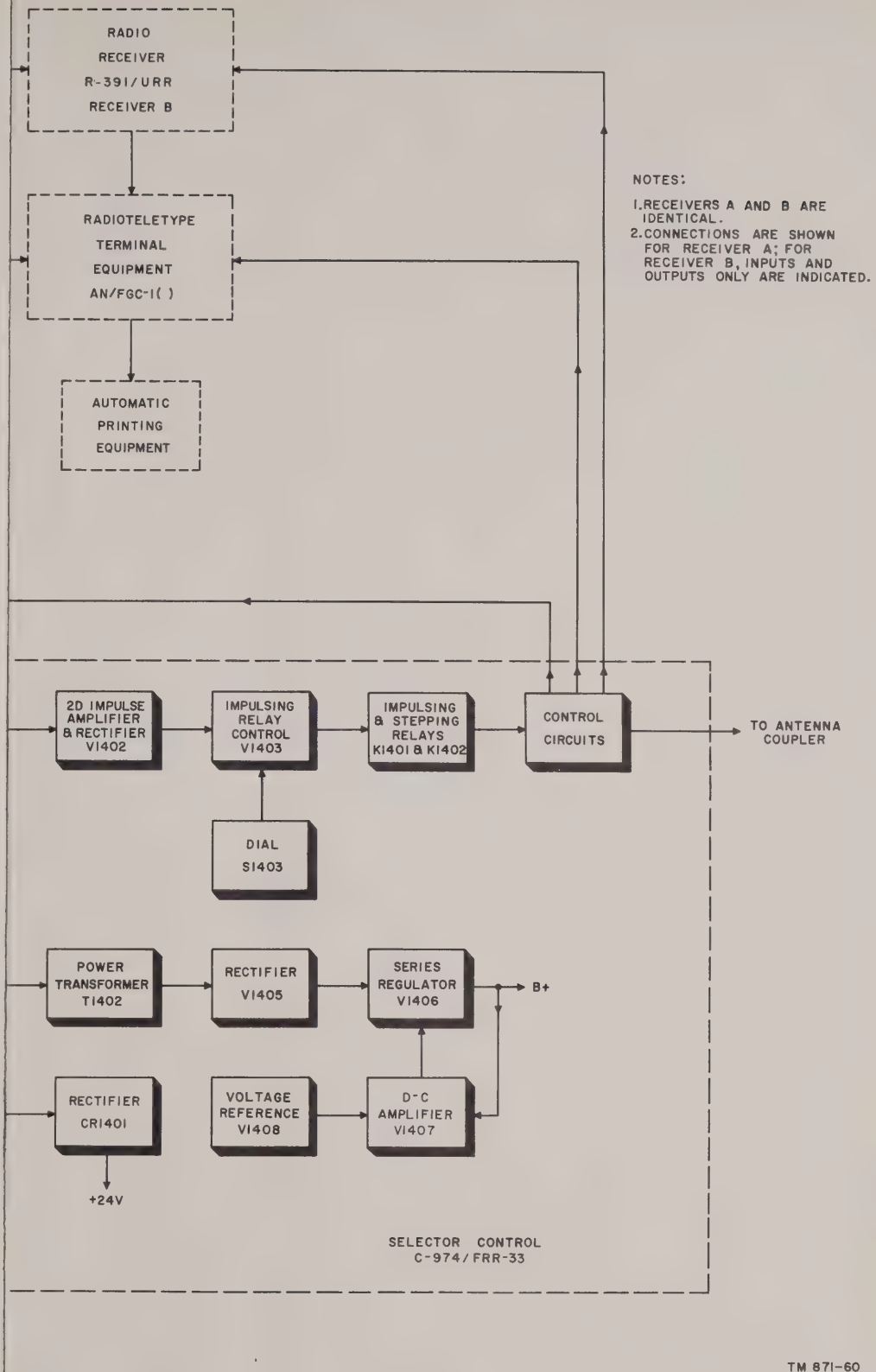


Figure 60. Radio Receiving Set AN/FRR-33, unit block diagram.

F1802, located within the switch-box. Throwing the main switch to ON causes the following action:

(1) *Antenna Coupler CU–286/FRR–33.* Ac power is applied to power input receptacle J1342 through Power Cable Assembly CX–1358/U. The circuit is completed through contact D of receptacle J1342, fuse F1301, the primary of transformer T1314, 115/230-volt switch S1302, Section 1 of the OFF-REMOTE-ANT 1-ANT 2 switch, to contact A of receptacle J1342. The primary of relay power transformer T1314 is connected in parallel with the primary of transformer T1313.

(2) *Radio Receiver R–391/URR (receiver B).* Ac power is applied to receiver B through a circuit arrangement similar to that of the antenna coupler. The basic difference is the addition of a pi-type filter in each side of the ac input line. Power is supplied to the radio receiver through Power Cable Assembly CX–1358/U to POWER receptacle J104. The circuit is then completed from contact D of receptacle J104 through one section of line filter FL101, fuse F101, contacts 9 and 11 of jack and plug P118 and J818, section C of FUNCTION switch, contact 2 of jack and plug P118 and J818, primary of transformer T801, 115/230-volt switch S801, contact 1 of plug-and-jack P112 and J818, the other section of line filter FL101, to contact A of receptacle J104.

(3) *Radio Receiver R–391/URR (receiver A).* Ac power is applied to receiver A through a circuit identical to that of receiver B.

(4) *Receiver Control C–975/URR.* 115/230-volt power is applied to power input receptacle J1570 through Power Cable Assembly CX–1358/U. The circuit is then completed through contact D of receptacle J1570, fuse F1501, primary of power transformer T1509, 115/230-volt switch S1503, section 3 of OFF-BFO-AFC switch S1501, to contact A of receptacle J1570.

(5) *Power Supply PP–629/URR.* Ac power is supplied to the power supply through Power Cable Assembly CX–1358/U. The power input receptacle is J1131. The circuit is completed from contact D of receptacle J1131 through fuse F1101, primary of transformer T1101, 115/230-volt switch S1101, ON-OFF switch, fuse F1102, to contact A of receptacle J1131.

(6) *Selector Control C–974/FRR–33.* Contacts A and D of receptacle J1132 (located on Power Supply PP–629/URR) are connected in parallel with 115/230-volt contacts A and D of receptacle J1131. Ac voltage is then supplied to power input receptacle J1453 by means of Electrical Power Cable Assembly CX–2751/U, connected between receptacles J1132 and J1453. The circuit is then completed from contact D of receptacle J1453 through fuse F1401, primary of transformer T1402, 115/230-volt switch S1406, section 3 of OFF-REMOTE-LOCAL switch S1402, to contact A of receptacle J1453. The primary of relay power transformer T1403 is connected in parallel with the primary of power transformer T1402.

(7) *Radioteletype Terminal Equipment AN/FGC–1( ).* Contacts A and G of receptacle J1458 (located on the selector control) are connected in parallel with the primaries of transformers T1402 and T1403. Ac power is then taken from this receptacle by means of Electrical Power Cable Assembly CX–2755/U and applied to receptacle J1773 in the junction box (fig. 3). Receptacle J1773 is wired internally to receptacle J1775. The power cord supplied with the radioteletype terminal equipment plugs into receptacle J1775. Contacts A, B, and F of receptacle J1458 are connected to contacts of stand-by relay K1411. For a complete discussion of the stand-by circuit, see paragraph 91. Refer to TM 11–356 for information concerning ac distribution within the radioteletype terminal equipment.

c. Channel Selection (fig. 62). Selection of a channel is possible from either a local or remote position. In the local position operation of the dial on Selector Control C–974/FRR–33 controls channel selection. The dial on Remote Switching Control C–973/FRR–33 controls channel selection from a remote position. The diagram in figure 62 assumes the previous selection of channel 4. Refer to paragraphs 80 and 81 for a discussion of the circuits involved in this selection. Autopositioner motor B1401 drives section 1 of switch S1405 until channel 4 position is reached. The remaining switch sections complete circuits as shown in figure 62. Section 2 of switch S1405 completes the circuit for the CHANNEL indicating lamp. Section 3 provides a ground return for operation of the Autotune in the antenna coupler. Sections 4 and 5 connect the rf sensitivity controls (located in the antenna coupler) to the proper cathode returns in the two receivers. Sections 6 and 7 provide ground return circuits for the Autotunes in receiver B and receiver A. The Autotunes in the various units then operate to select channel 4 circuits.

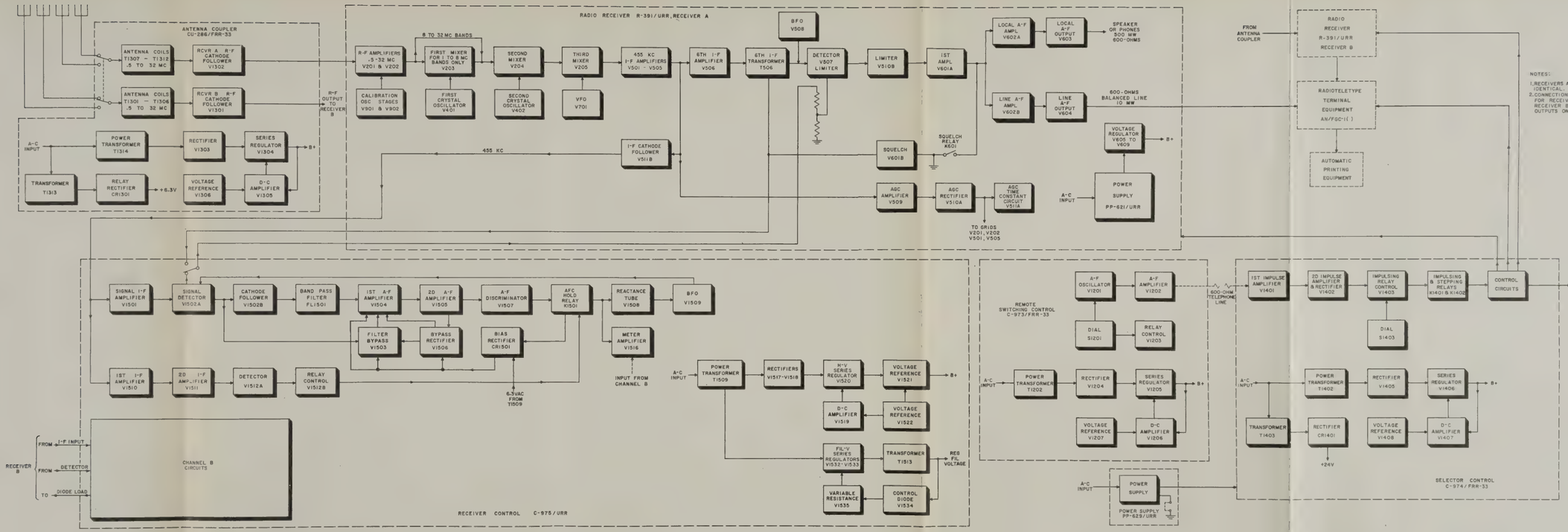


Figure 60. Radio Receiving Set AN/FRR-33, unit block diagram.

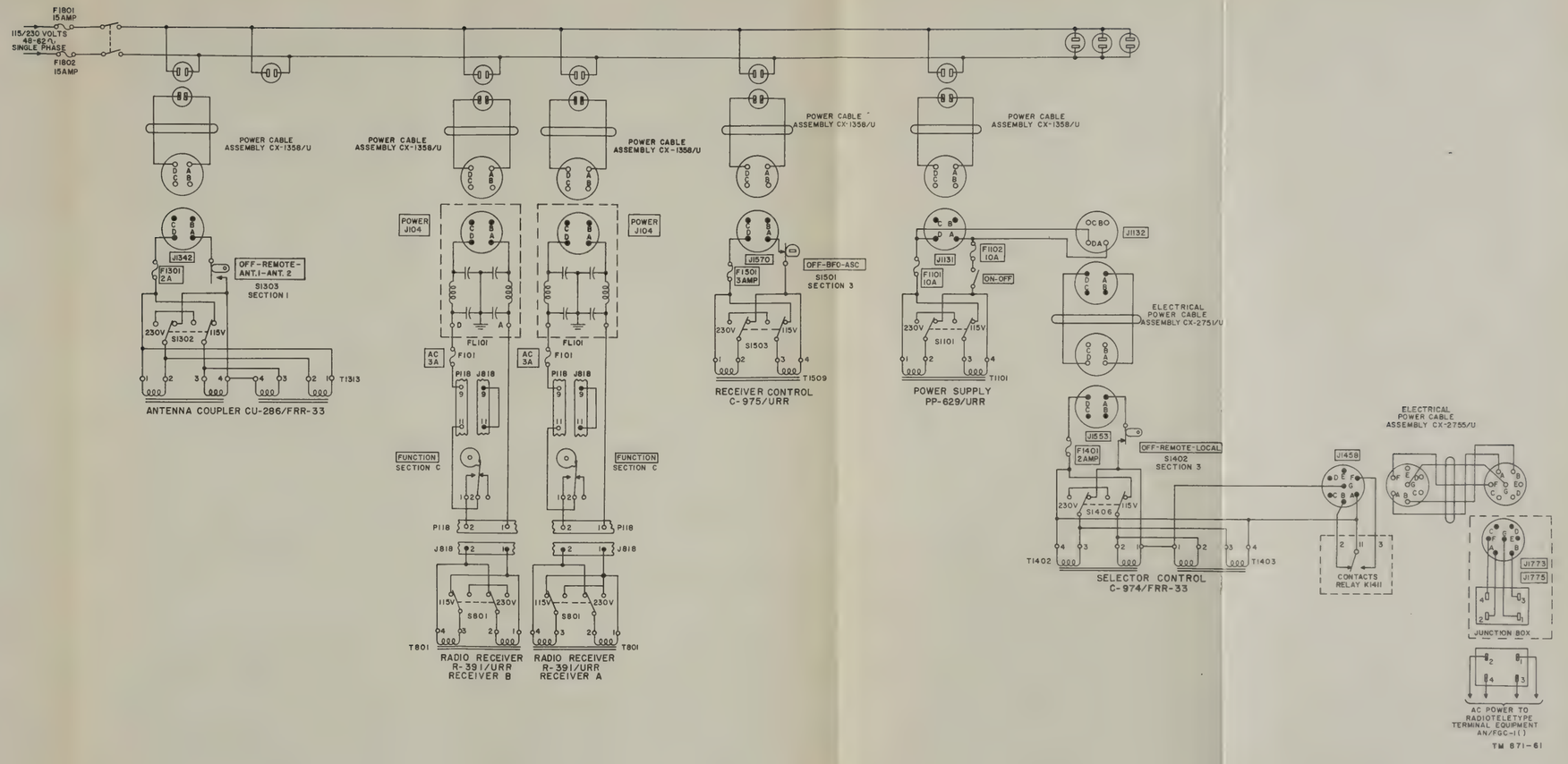
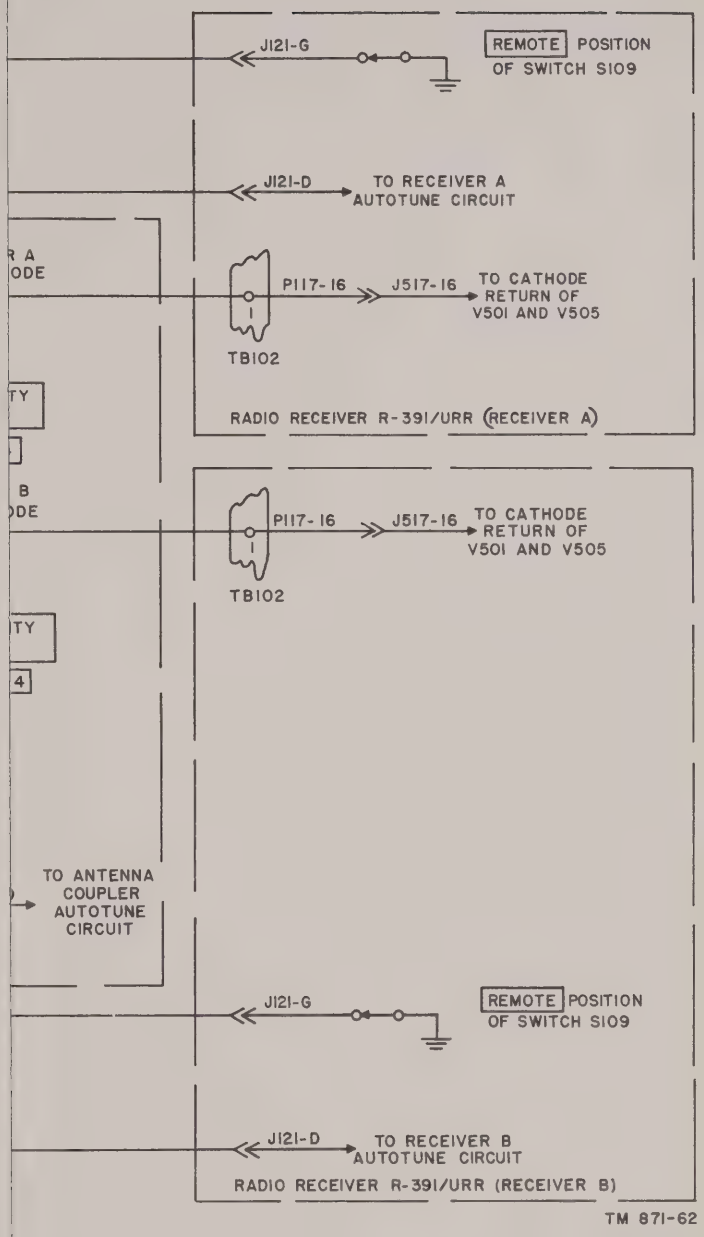


Figure 61. Radio Receiving Set AN/FRR-33, ac power distribution diagram.



N/FRR-33, channel selection, schematic diagram.

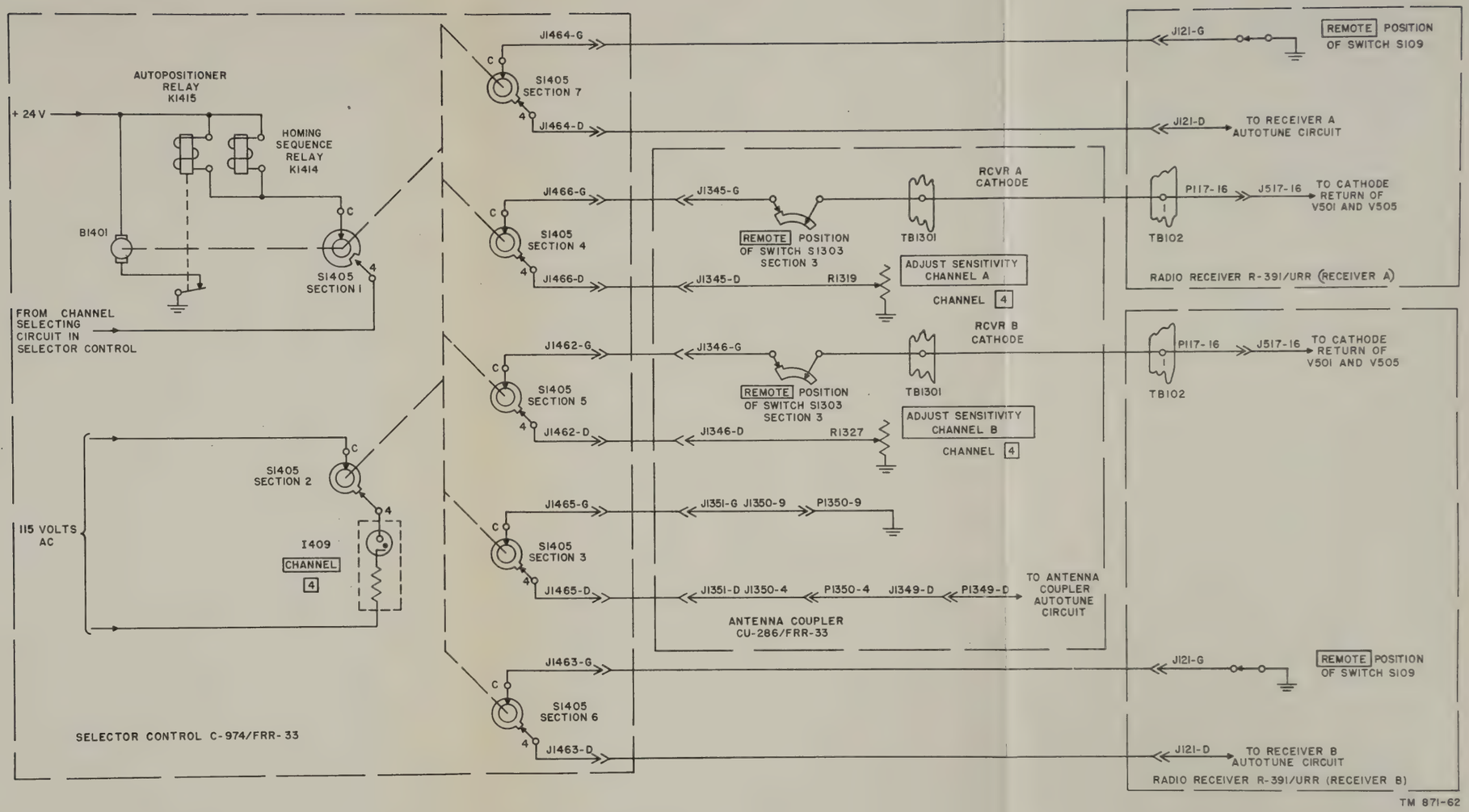


Figure 62. Radio Receiving Set AN/FRR-33, channel selection, schematic diagram.

d. Autotune Power Distribution (fig. 63). With one exception all of the Autotunes obtain +24 volts from Power Supply PP–629/URR. The Autopositioner unit in the Selector Control C–974/FRR–33 obtains operating voltage from a separate power supply located in the selector control. Autotune muting relay K1403 is connected in the +24-volt supply line from Power Supply PP–629/URR. Therefore, when any one of the Autotune units in the receivers or antenna coupler operates, relay K1403 is energized. The resultant muting action is described in subparagraph *e* below. Interconnections involved in the Autotune power circuit are shown in figure 63.

e. Autotune Muting Circuit (fig. 64). During the operation of any of the Autotunes in the antenna coupler or receivers, Autotune muting relay K1403 is energized. As indicated in figure 64, the Autotune circuits are completed through receptacles J1455, J1456, and J1459 of Selector Control C–974/FRR–33. Relay K1403 is connected between these receptacles and +24 volts (through receptacle J1453). When any one of the Autotunes functions, sufficient current flows through the winding of relay K1403 to energize it. Operation of relay K1403 results in the following: opens the ground return circuit of stepping relay K1402 (contacts 6 and 7 of relay K1403), energizes disable relay K1413 (contacts 5 and 6), and opens the ground return circuit for the relay power supply in Receiver Control C–975/URR (contacts 6 and 7). Operation of disable relay K1413 results in the disabling of the radioteletype terminal equipment. Removal of the ground return in the receiver control prevents the afc hold relays from operating, thus preventing afc action during operation of the Autotunes.

f. Antenna Selection Circuit (fig. 65). When antenna coupler switch S1303 (OFF-REMOTE-ANT 1-ANT 2) is placed in the REMOTE position, selection of a particular pair of antennas is determined by circuits in Selector Control C–974/FRR–33. Dial positions 01 and 02 control the antenna selection. When 01 is dialed the ANT 1 control portion of relay K1409 is energized, latching the contacts as shown in figure 65. This opens the ground return circuit of the relay power supply located in the antenna coupler and relays K1301 and K1302 are inoperative. In this position ANT 1 antennas are coupled to the input circuits of the equipment. Similarly, dialing 02 results in the operation of relays K1301 and K1302 and ANT 2 antennas are selected Antenna control relay K1409 remains latched in the last position dialed until the other pair of antennas is selected by dialing 01 and 02 as the case may be.

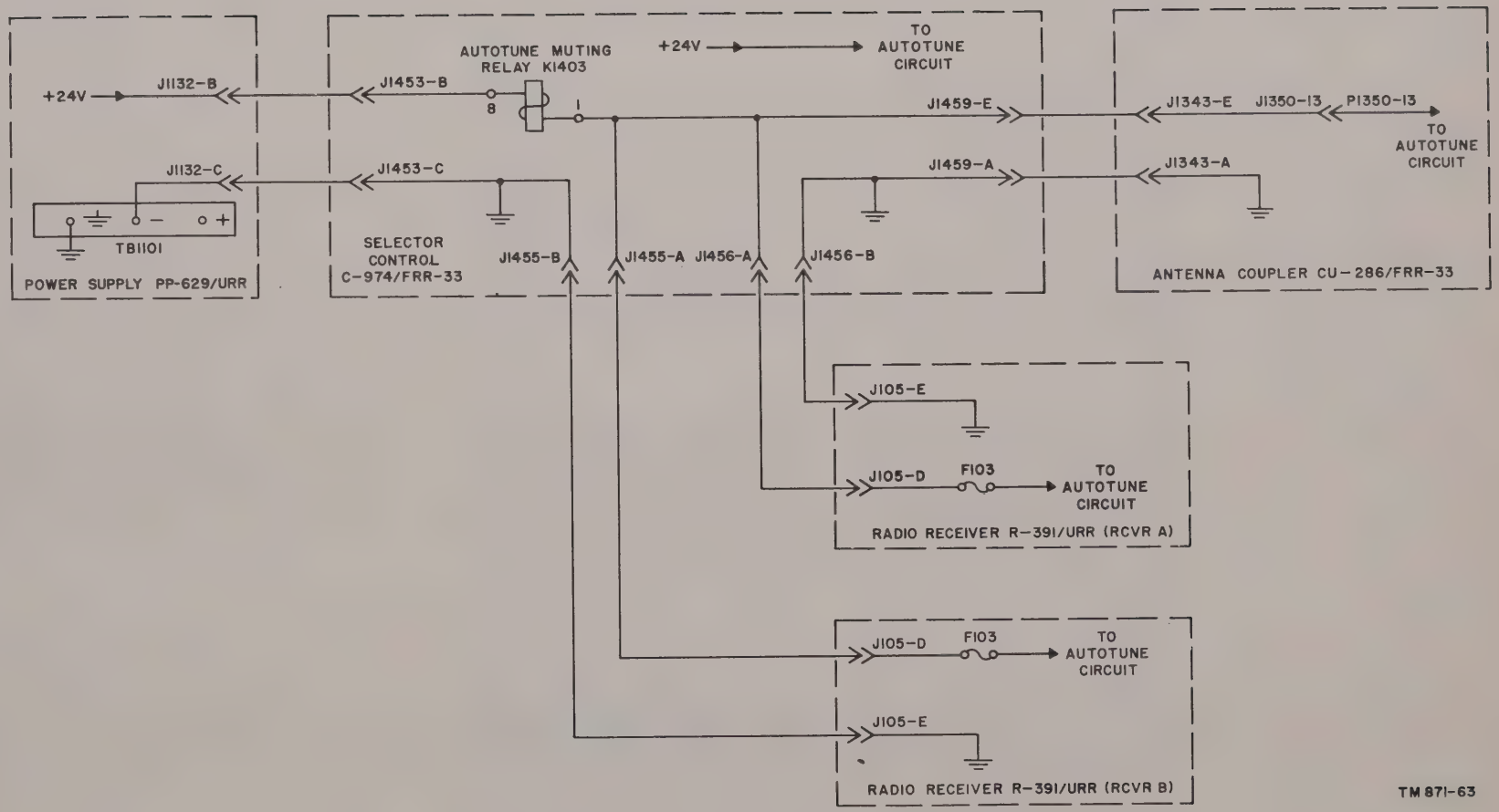


Figure 63. Radio Receiving Set AN/FRR-33, Autotune power distribution schematic diagram.

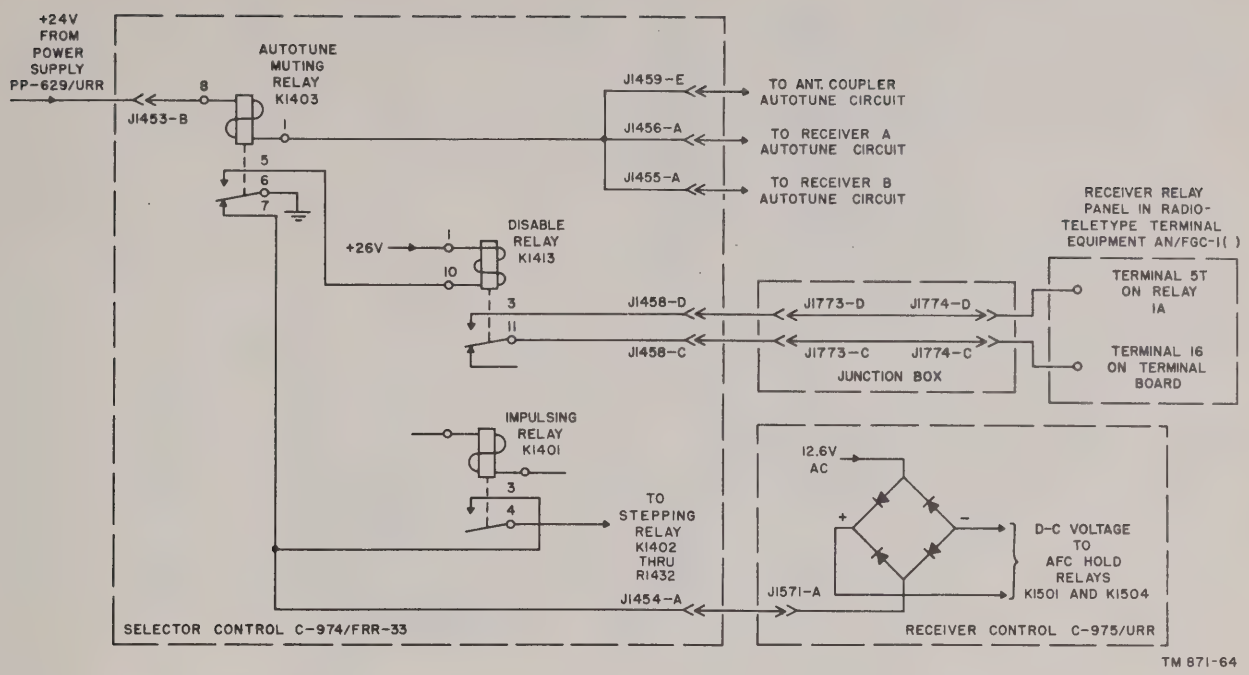


Figure 64. Radio Receiving Set AN/FRR-33, Autotune muting circuit, schematic diagram.

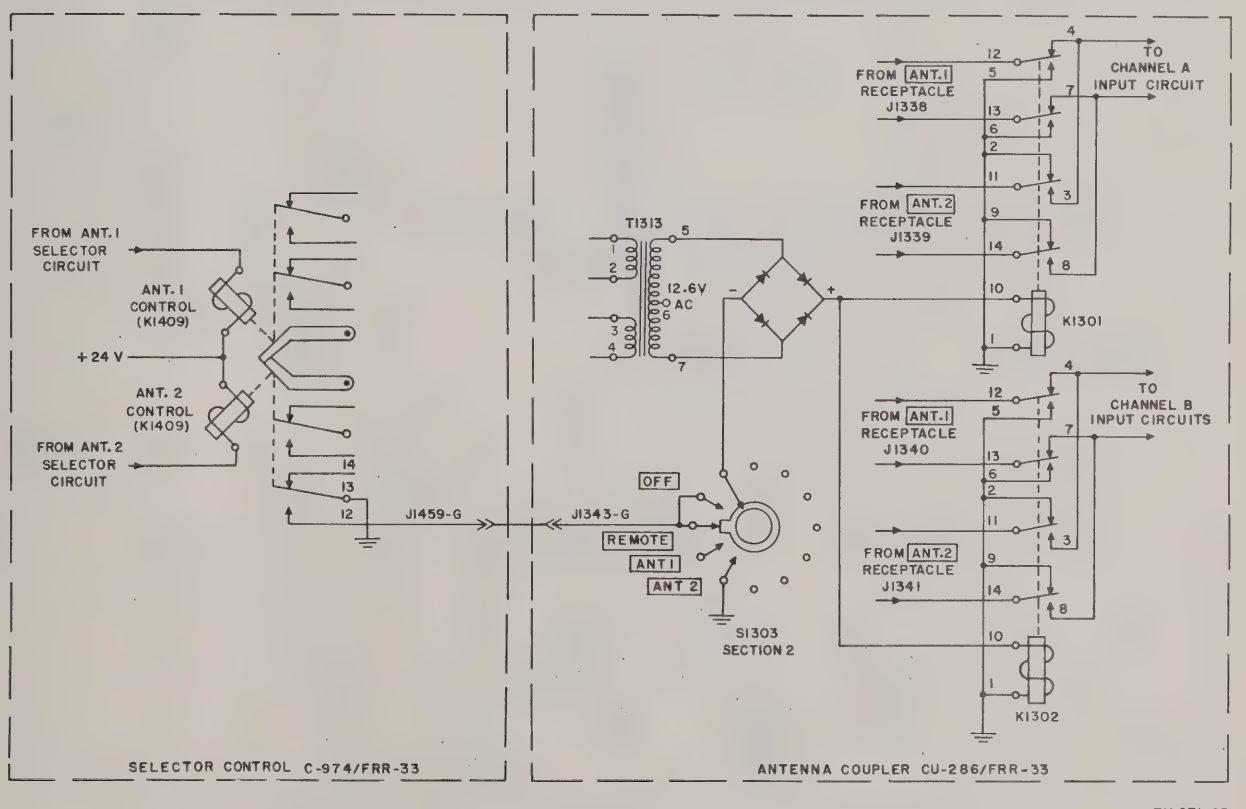


Figure 65. Radio Receiving Set AN/FRR-33, antenna selection circuit, schematic diagram.

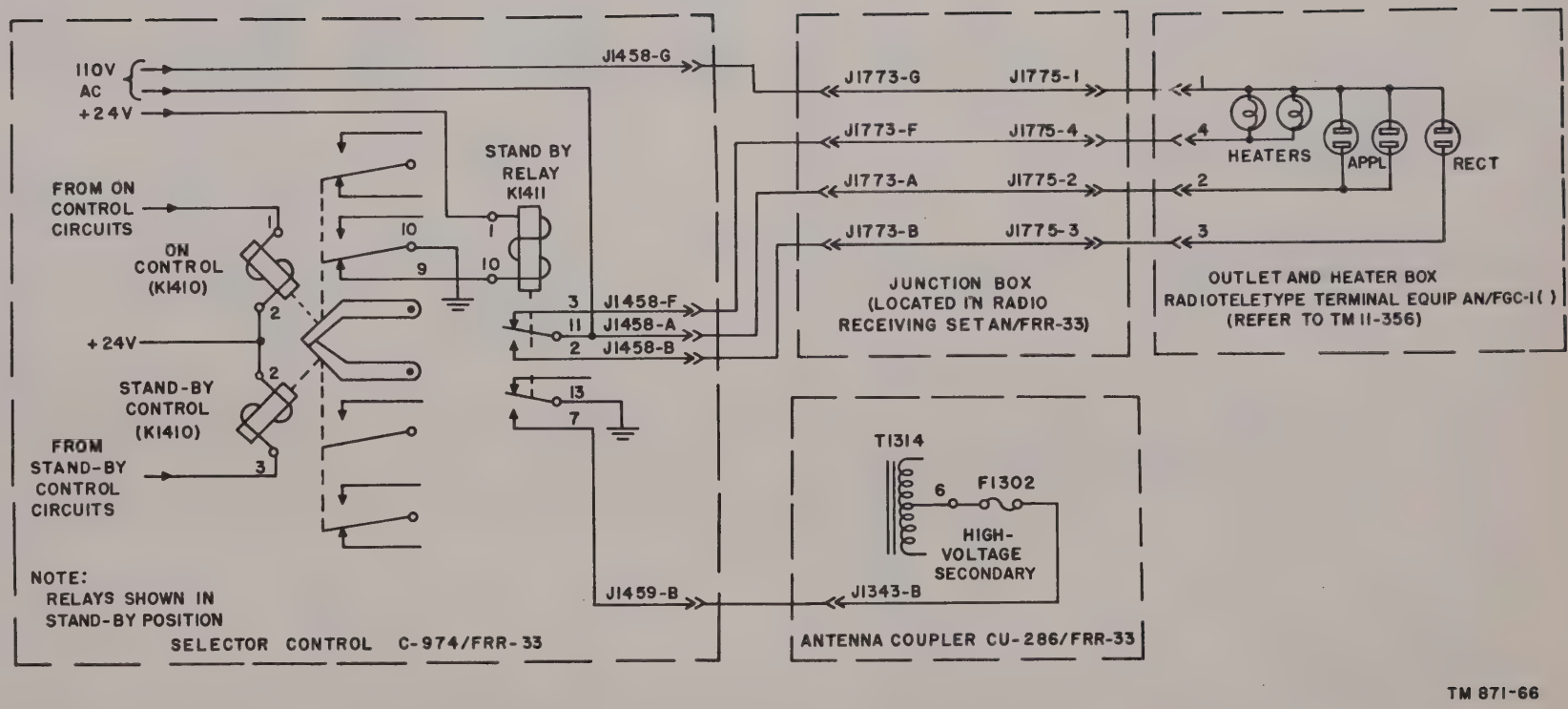


Figure 66. Radio Receiving Set AN/FRR-33, stand-by circuit, schematic diagram.

g. Stand-by Circuit (*fig. 66*). Stand-by control is provided by dial position 06. When 06 is dialed, circuits in the selector control operate to energize the stand-by control portion of relay K1410. Contacts 9 and 10 then provide a ground return for stand-by relay K1411. Relay K1411 operates, resulting in the following: ac voltage is removed from the rectifier circuit in the radioteletype terminal equipment and applied to heaters in the equipment; the center-tap ground return for high-voltage transformer T1314 of Antenna Coupler CU–286/FRR–33 is broken, disabling the antenna coupler.

h. Disable Circuit (*fig. 67*). The disable circuit is similar to the stand-by circuit. The disable control portion of relay K1412 is energized as a result of dialing 03. This operates disable relay K1413 as shown in figure 67. (Disable relay K1413 is also energized during Autotune operation as described in subparagraph *e* above). Contacts 3 and 11 of relay K1413 complete a circuit to place the radioteletype terminal equipment in the "steady mark" position. Unlike the stand-by position, in the DISABLE position, Radio Receiving Set AN/FRR–33 remains operative. This allows the operator to check various functions of the radio receiving set without operating the teletypewriter equipment.

i. On Circuits. As can be seen in figures 66 and 67 both relays K1410 and K1412 contain "on control" coils. Since one relay normally will be in the "on control" position depending upon the previous selection of either stand-by or disable, the other relay will operate, placing both relays K1410 and K1412 in "on" position. Tl is opens the disabling and/or stand-by circuits and the equipment is ready to operate.

Note. While both 03 and 06, DISABLE and STANDBY, may be dialed in succession placing both relay K1410 and relay K1412 in the stand-by control and disable control position, respectively, the disable circuit performs no useful function in this case. As soon as standby is dialed, power is automatically removed from all relay circuits in the radioteletype terminal equipment. Thus, dialing disable cannot operate relays 1A and 2A on the receive relay panel as would normally occur, since no relay power is available. The disable position is used when it is desirable to have the radioteletype terminal equipment in a non-functioning condition, but with tube filaments heated for instant operation when necessary. Therefore, if a disabling condition is required and the equipment is previously in the STANDBY position, the ON position must be dialed before selecting the DISABLE position.

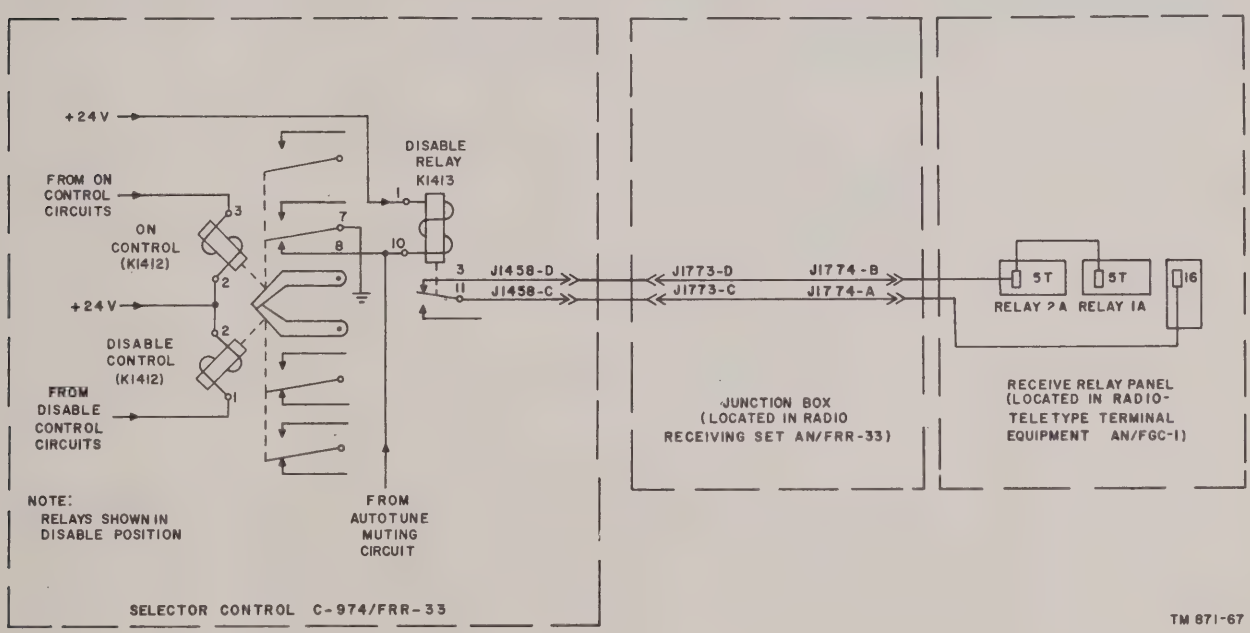
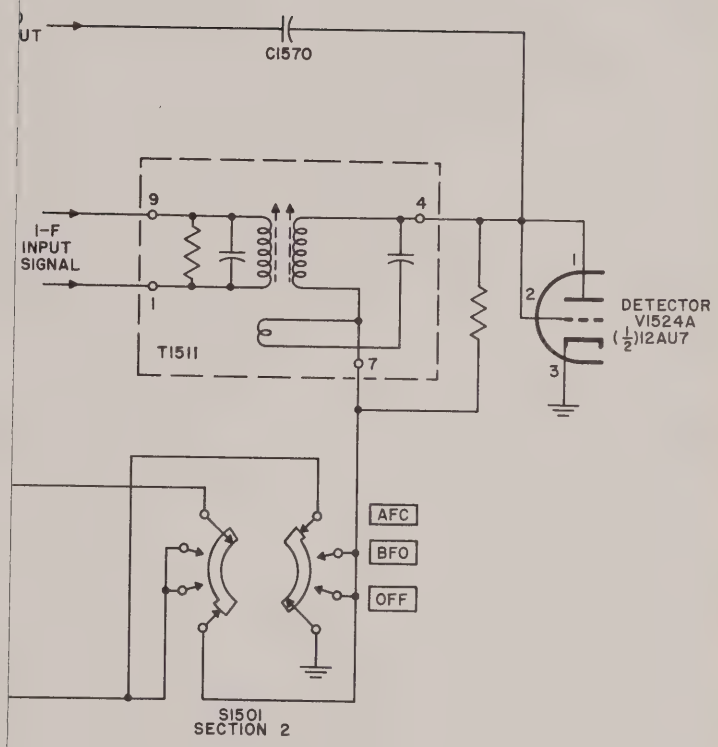


Figure 67. Radio Receiving Set AN/FRR-33, disable circuit, schematic diagram.

j. Bfo–afc Circuit (*fig. 68*). Radio Receiving Set AN/FRR–33 may operate with or without afc circuits, depending on the position of the OFF-BFO-AFC switch of Receiver Control C–975/URR. In the BFO position, output of detector stage V507A of each receiver is coupled through Electrical Special Purpose Cable Assembly CX–2753/U (one cable for each receiver) to the receiver control, through contacts of OFF-BFO-AFC switch S1501, back through the cable to the diode load of the receiver. The bfo of each receiver then must be operated for proper radioteletype reception. In the AFC position the bfo for each receiver is furnished by the receiver control. A diagram of the switch circuit is shown in figure 68.



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AN/FRR-33, bfo-afc circuit, schematic diagram.

j. Bfo–afc Circuit (*fig. 68*). Radio Receiving Set AN/FRR–33 may operate with or without afc circuits, depending on the position of the OFF-BFO-AFC switch of Receiver Control C–975/URR. In the BFO position, output of detector stage V507A of each receiver is coupled through Electrical Special Purpose Cable Assembly CX–2753/U (one cable for each receiver) to the receiver control, through contacts of OFF-BFO-AFC switch S1501, back through the cable to the diode load of the receiver. The bfo of each receiver then must be operated for proper radioteletype reception. In the AFC position the bfo for each receiver is furnished by the receiver control. A diagram of the switch circuit is shown in figure 68.

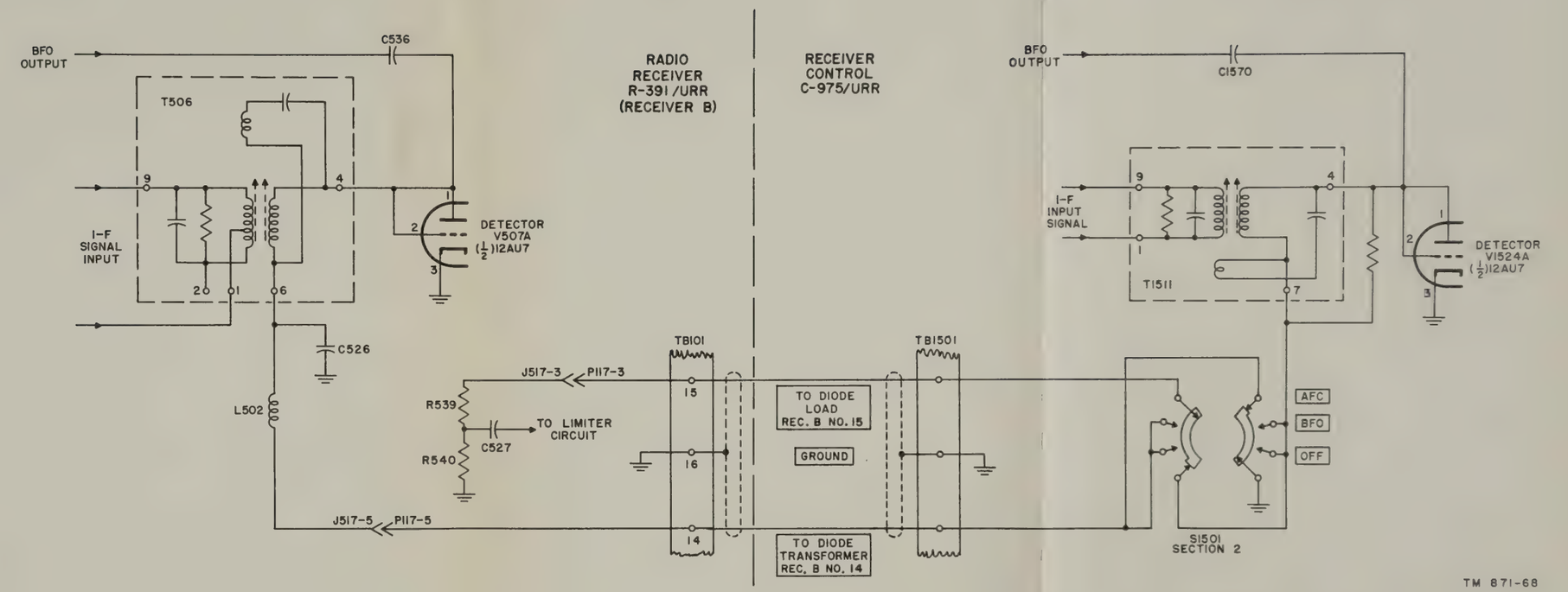

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Figure 68. Radio Receiving Set AN/FRR-33, bfo-afc circuit, schematic diagram.

CHAPTER 5
UNIT THEORY

Section I. THEORY OF ANTENNA COUPLER CU–286/FRR–33

76. Block Diagram

Antenna Coupler CU–286/FRR–33 provides circuits for coupling antennas to the two receivers. In figure 69 circuits for one receiver are designated "receiver A" and the other circuits are designated "receiver B." The circuits for each receiver include a set of antenna transformers and a cathode follower to match the output impedance of an antenna transmission line to the receiver input circuit. Two antenna connections are provided for each receiver. This permits connection of each receiver to either one of two separate antennas. The antenna coupler also includes relays for switching the antennas, an Autotune system for bandswitching and tuning, a 6.3-volt dc supply for relay operation, and a plate and filament voltage supply.

77. Antenna System

a. Four antennas are connected through their transmission lines to antenna receptacles J1338 through J1341 (fig. 39). One pair of antennas is connected when

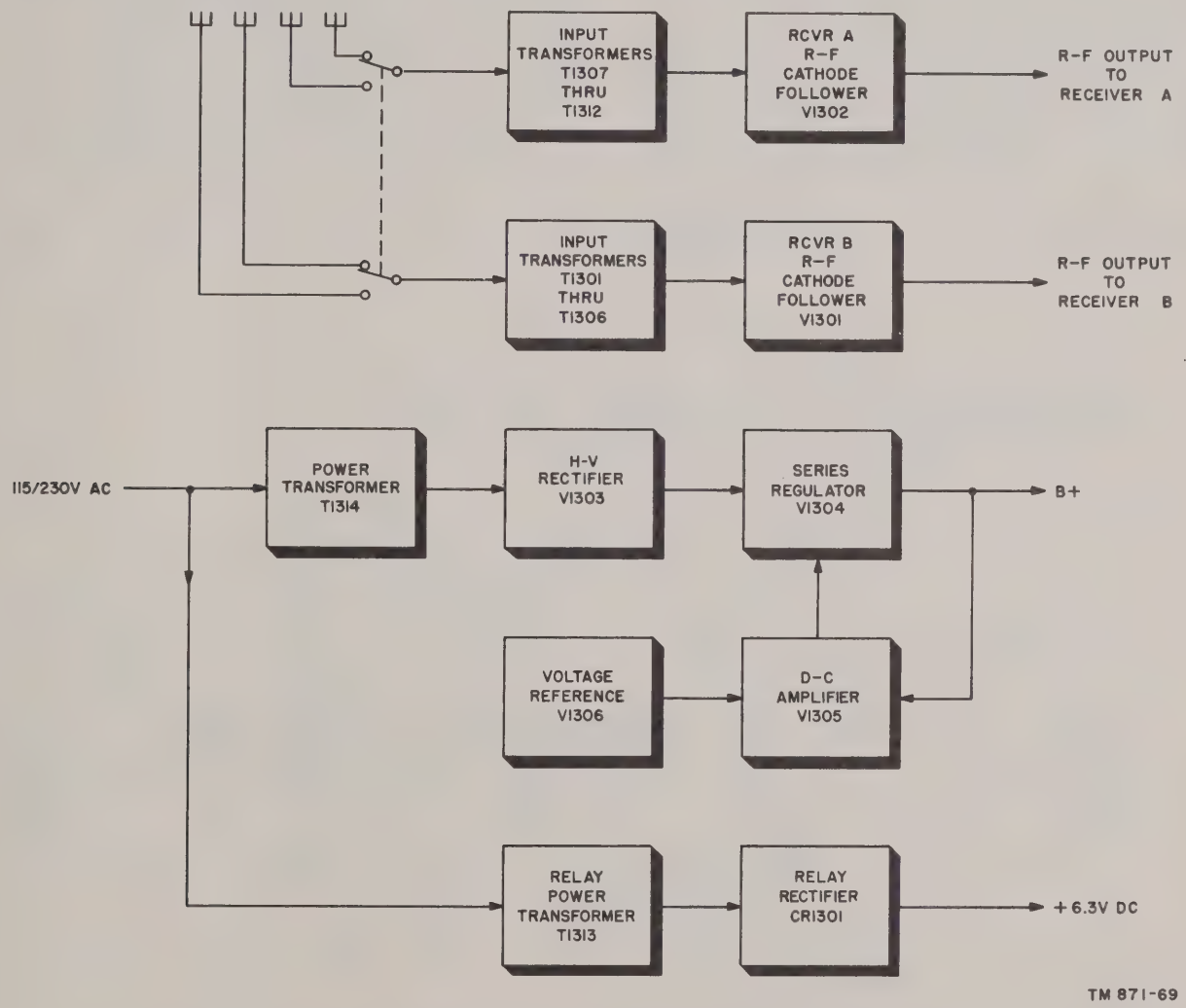

Figure 69. Antenna Coupler CU-286/FRR-33, block diagram.

ANT 1 is selected; a second pair is connected for ANT 2 position. Normally the antennas of ANT 1 are directed in a direction different from those of ANT 2. The direction from which the signal is to be received determines the pair of antennas selected.

b. The antennas are usually selected through operation of Selector Control C–974/FRR–33. When switch S1303 is placed in the REMOTE position power is applied to relay power transformer T1313, the rf sensitivity control circuits are transferred from the receivers to the antenna coupler (fig. 62), and operating circuits of antenna relays K1301 and K1302 are connected to Selector Control C–974/FRR–33 (fig. 65). ANT 1 or ANT 2 is selected by means of the circuit described in paragraph 75*f* and illustrated in figure 65. The transmission lines of the two antennas not in use are grounded through contacts of relays K1301 and K1302. This prevents interference from stray coupling that exists between the unused antennas and antenna input circuits.

c. ANT 1 or ANT 2 can also be selected locally by placing OFF-REMOTE-ANT 1-ANT 2 switch S1303 in the proper position. Placing the switch in ANT 1 position opens the ground return circuit of the relay power supply, insuring the release of relays K1301 and K1302. Placing the switch in ANT 2 position provides a ground return for the relay power supply and energizes relays K1301 and K1302, thus selecting the antennas of ANT 2 position.

78. Input and Cathode Follower Circuits (fig. 70)

a. Input Circuit. Rf input signal developed in the antennas is coupled to each rf cathode follower through one of six input transformers, the particular transformer being determined by the frequency of the desired signal. Since receiver A and receiver B circuits are identical except for component reference symbols, only the receiver A circuit will be discussed. Rf input is applied to the primary of a selected transformer (T1307 through T1312) through contacts of relay K1301 and sections 2 and 3 of switch S1301. The Autotune system described in paragraph 82 provides bandswitching and tuning of the transformers. Six transformers cover the complete frequency range of .5 to 32 mc. Transformer T1307 covers .5 to 1 mc; transformer T1308, 1 to 2 mc; transformer T1309, 2 to 4 mc; transformer T1310, 4 to 8 mc; transformer T1311, 8 to 16 mc; and transformer T1312, 16 to 32 mc. When the lowest frequency range is selected,

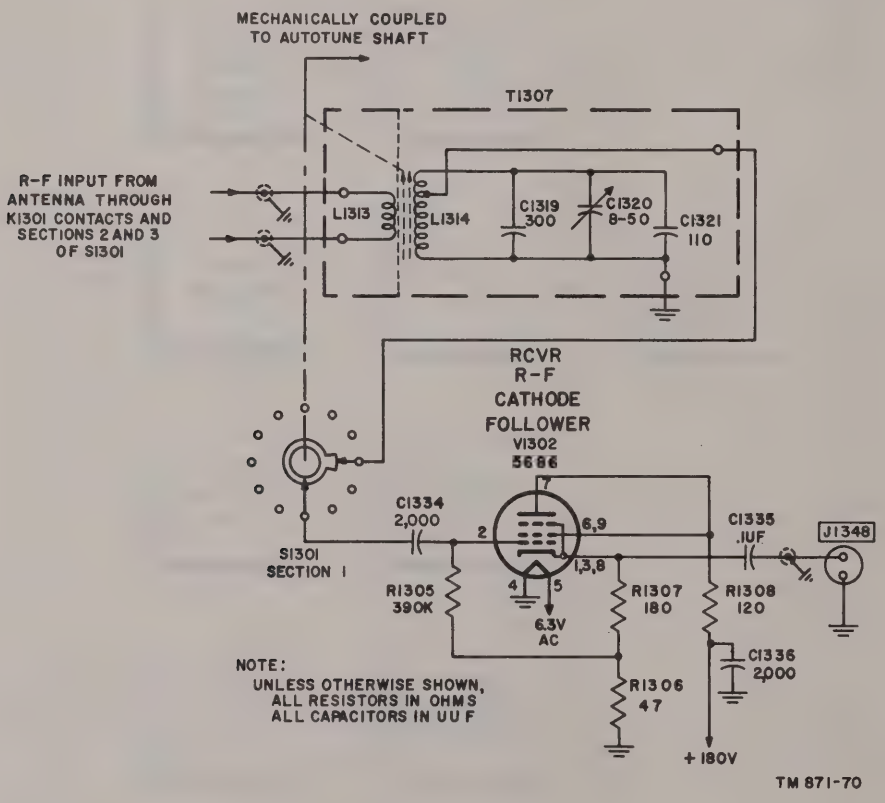

Figure 70. Antenna Coupler CU-286/FRR-33, input and cathode follower circuits, schematic diagram.

the rf signal is applied to inductor L1313, the untuned primary of transformer T1307. Rf voltage is then inductively coupled to a tuned secondary circuit consisting of inductor L1314 and capacitors C1319, C1320, and C1321. Inductor L1314 is tuned by a powdered iron slug. The slug is positioned by a rack in conjunction with the Autotune system. Capacitors C1319 and C1321 resonate the secondary to the proper frequency while C1320 is a trimmer capacitor for fine tuning adjustment.

b. Rcvr. A Rf Cathode Follower Circuit.

(1) In order to properly match the antenna circuit to the input impedance of receiver A, a cathode follower circuit is used. Since negative signals of high amplitude result in cut-off limiting in an ordinary cathode follower a modified circuit is used to prevent this.

(2) Tube V1302 is connected for triode operation with the plate and screen grid connected. B+ is applied to this common connection through voltage-dropping resistor R1308. Decoupling from the other cathode follower is provided by bypass capacitor C1336. Bias for the stage is determined by the dc voltage developed across cathode resistor R1307, since the control grid is returned through resistor R1305 to one side of resistor R1307. Resistor R1306 is part of the cathode voltage-dividing circuit determining the voltage developed across resistor R1307.

(3) Rf voltage induced in the secondary of transformer T1307 is applied to the control grid of tube V1302 through coupling capacitor C1334. Voltage variations on the control grid are reflected as changes in voltage across the cathode resistors, since the cathode is not bypassed to ac. Output signal developed across series resistors R1306 and R1307 is applied to output receptacle J1348 through coupling capacitor C1335. Since grid resistor R1305 is terminated at a more positive point than it would be if connected directly to ground, the bias on the control grid is reduced. Therefore, input voltage can swing to a greater negative value without cutting off the tube.

c. Rcvr. B Rf Cathode Follower Circuit. The input and cathode follower circuit for receiver B is identical to that for receiver A. A common B+ decoupling circuit is connected in the plate voltage supply of the two tubes. This circuit consists of resistor R1332 and two bypass capacitors C1318 and C1336 (fig. 123).

79. High-Voltage Power Supply
(fig. 71)

a. The high-voltage power supply contains a regulated B+ supply and a source of 6.3 volts ac filament voltage.

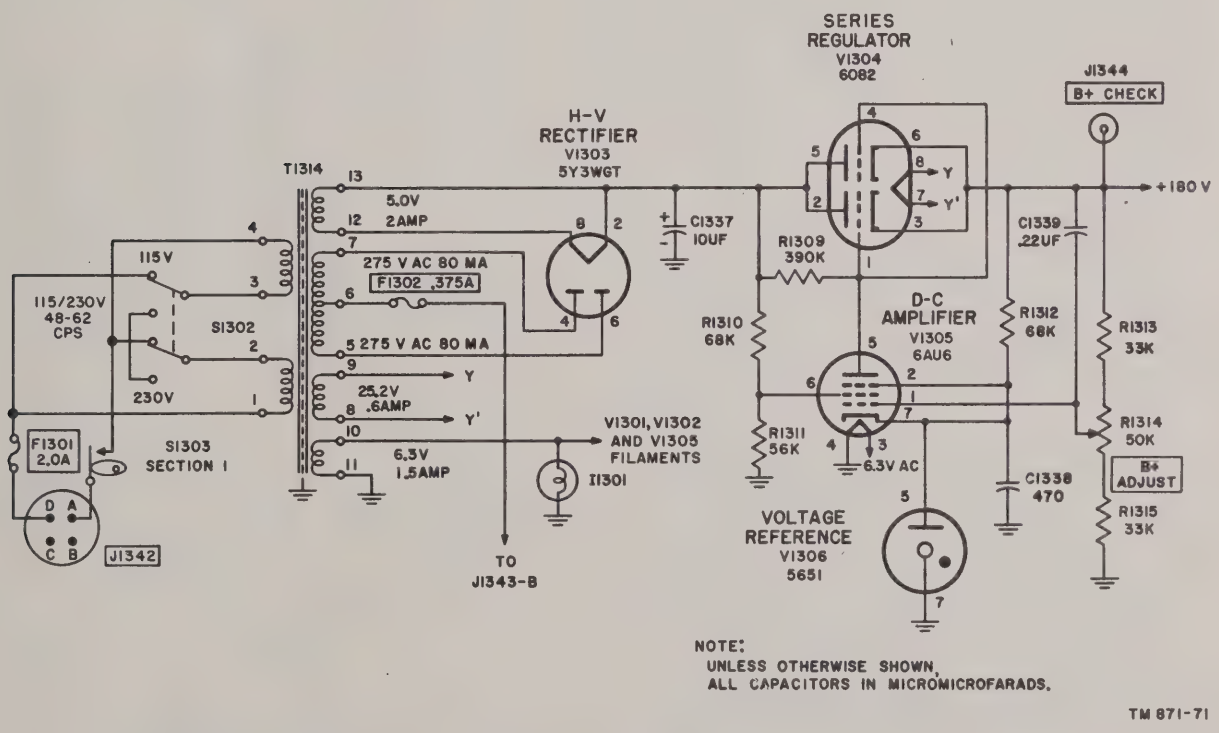

Figure 71. Antenna Coupler CU-286/FRR-33, high-voltage power supply, schematic diagram.

Power transformer T1314 has two primary windings which are parallel-connected for 115-volt operation and series-connected for 230-volt operation. A 48–62 cps, single-phase, ac source is connected to the primary windings of transformer T1314 through terminals A and D of power receptacle J1342, a 2-ampere fuse F1301, section 1 of OFF-REMOTE-ANT 1-ANT 2 switch S1303, and 115/230-volt switch S1302. The 115/230-volt switch is held in the desired position by a retaining bracket mounted to the chassis with two screws.

b. Ac plate voltage is supplied to the plates of a type 5Y3WGT rectifier tube (V1303). A .375-ampere fuse is connected from the center tap of the high voltage winding to contact B of function control receptacle J1343. When Radio Receiving Set AN/FRR–33 is in stand-by condition, contacts of the stand-by relay in the selector control are open and contact B of receptacle J1343 is not grounded. When the radio receiving set is on the contacts are closed, contact B is grounded, and the high voltage power supply functions. (Refer to paragraph 75*g* for a discussion of the stand-by circuit.) The output of rectifier tube V1303 is filtered by a single capacitor, C1337.

c. Voltage regulation of the B+ output voltage is provided by series regulator V1304 (6082), dc amplifier V1305 (6AU6), and voltage reference tube V1306 (5651). A series circuit, consisting of plate load resistor R1309, plate-to-cathode circuit of dc amplifier tube V1305, and voltage reference tube V1306 is connected from the rectifier output to ground. The cathode of the dc amplifier is maintained at a substantially constant voltage by the voltage reference tube. Regulator output voltage is applied to a voltage divider circuit consisting of resistors R1313 and R1315 in series with potentiometer R1314. Voltage variations appearing between the arm of potentiometer R1314 and ground are applied to the control grid of the dc amplifier to be compared to the cathode voltage. Thus, any change in B+ output voltage is reflected as a change in the grid-to-cathode voltage of dc amplifier V1305. This change is amplified by tube V1305 and applied to the parallel-connected control grids of series regulator tube V1304. Since these changes in control grid voltage (grid of tube V1304) are 180 degrees out of phase with the changes occurring in the regulated output, the voltage drop from the cathodes to plates of series regulator V1304 is changed sufficiently in the correct phase relationship to compensate almost entirely for the original voltage change. Capacitor C1339 is connected between the output voltage and the control grid of the dc amplifier to obtain additional compensation for 120-cycle ripple voltage appearing in the output. The screen grid circuit of tube V1305 is also designed to decrease output voltage variations. A screen grid voltage-divider circuit, consisting of resistors R1310 and R1311, is connected between B+ and ground ahead of the regulator circuit. The screen grid voltage therefore varies in phase with the control grid voltage and increases the effectiveness of the dc amplifier. The ADJUST B+ potentiometer (R1314) is set to maintain the output voltage measured at B+ CHECK test jack J1344 at 180 volts. Resistor R1312 is connected from the output circuit of the voltage regulator to the anode of the voltage reference tube to insure correct operating current for the reference tube.

d. Ac filament voltage to operate series regulator V1304 is obtained from a separate secondary winding on transformer T1314. Another 5-volt winding supplies the filament of hv rectifier V1303. A third winding supplies 6.3 volts for tubes V1301, V1302, and V1305. This secondary also supplies voltage to dial lamp I 1301.

80. Relay Voltage Power Supply
(fig. 72)

Voltage for operating relays K1301 and K1302 is obtained from a full-wave bridge rectifier, CR1301. An ac supply voltage of 12.6 volts for rectifier CR1301 is obtained from transformer T1313, which is connected in parallel with power transformer T1314. The ground return for the bridge rectifier circuit is connected to section 2 of OFF-REMOTE-ANT 1-ANT 2 switch S1303.

81. Rf Sensitivity Controls

a. When OFF-REMOTE-ANT 1-ANT 2 switch S1303 is placed in a position other than OFF, control of the rf sensitivity of each receiver is transferred to the antenna coupler. Sixteen sensitivity controls, one for each channel of each receiver, are located behind two doors built into the front panel of the antenna coupler. Controls for each channel are labeled 1 through 8. Two controls, one for each receiver, are adjusted for proper signal reception.

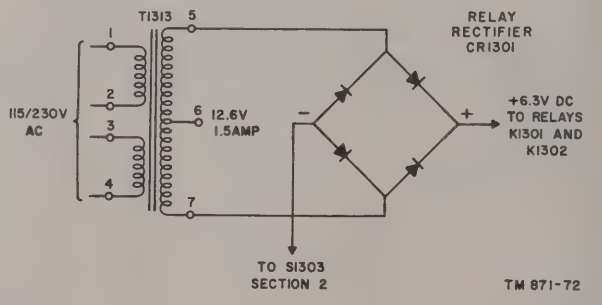

Figure 72. Antenna Coupler CU-286/FRR-33, relay voltage power supply, schematic diagram.

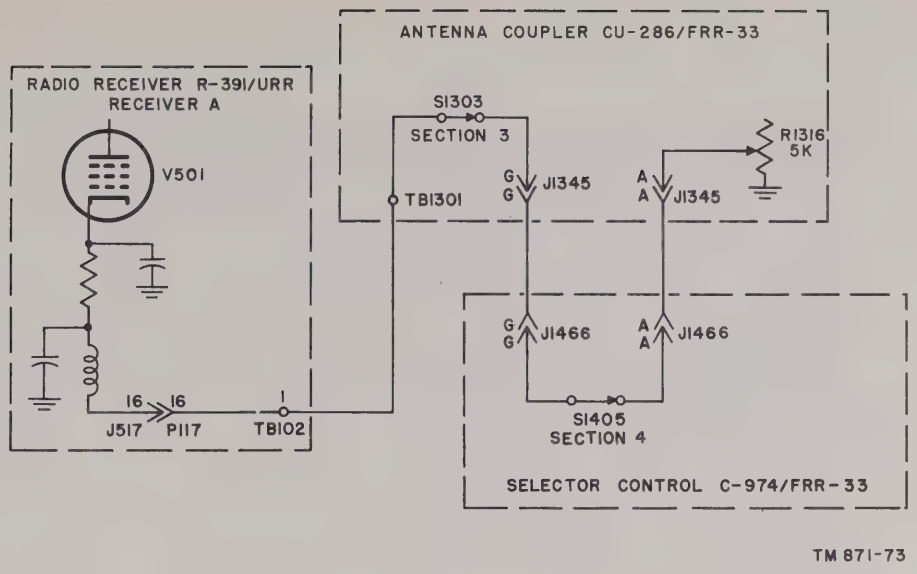

Figure 73. Antenna Coupler CU-286/FRR-33, rf gain control circuit, schematic diagram.

b. When Antenna Coupler CU–286/FRR–33 is functioning and the radio receiving set is operating on channel 1 the gain control circuit for receiver A extends through the following: from the cathode returns of tubes V501 and V505 in receiver A, through terminal board TB102–1, through terminal board TB1301, through contacts of switch S1303 section 3, through receptacle J1345–G, through interconnecting cables to receptacle J1466–G, through switch S1405 contacts, through receptacle J1463–A, through interconnecting cables to receptacle J1345–A, and through sensitivity control R1316 to ground. This path is shown in figure 73. A similar circuit can be traced for any channel of either receiver.

82. Description of Tuning

An Autotune assembly is located immediately behind the front panel of Antenna Coupler CU–286/FRR–33. This assembly, shown in figure 74, includes two singleturn positioning heads, a control head, and a motor. The control head contains switches for starting, stopping, or reversing the motor. Motor B1301 operates through a gearing arrangement to drive a line shaft, which in turn drives the two singleturn units and the control unit by means of three worm gears. Band switch S1301 is controlled by one singleturn unit; the input transformer tuning slugs are driven by the second singleturn unit.

a. Front and rear views of a singleturn unit are shown in figure 75. A functional diagram (fig. 76) shows mechanical details. Numbers in parentheses in the following discussion refer to keyed numbers in figure 76. Each singleturn unit includes a tuning shaft (17), a friction clutch for driving the shaft (4, 5, and 6), a cam drum (11) for releasing one of eight pawls (14), and a stack of stop rings (13), one for each channel. When a channel is selected the pawl (14) for that particular channel falls into a slot in its stop ring (13) to stop the tuning shaft (17). The tuning shaft (17) extends from the rear of unit; attached to this extension is a tunable element (19), such as band switch S1301 or the slug rack. A knob and locking key (16) extend from the front of the unit. The tuning shaft (17) is a part of the stop-ring shaft assembly that includes a worm gear (3), a friction clutch (4, 5, and 6), and eight spring-load stop-ring pawls (14). The pawls are equally spaced so that each stop-ring pawl heel (14A) rides on its corresponding cam-drum ring, as shown in B of figure 76. Worm gear (3) meshes with a worm gear (2) attached to the line shaft (1). When Autotune motor B1301 (fig. 74) operates, the tuning shaft (17) is driven through the worm gears and friction clutch. Also driven, through gears (7) and (8), is cam drum (11).

(1) During the first half of the Autotune cycle the tuning shaft (17) is driven counterclockwise (as viewed from the knob end) until home-stop ring (12) (A of fig. 76) strikes stop bar (20). This halts rotation of the stop-ring drum and causes the clutch to slip. However, the wheel gear (21) continues to rotate and drive the cam drum (11) counterclockwise. As the cam drum rotates each slot in the cam drum passes beneath its respective pawl heel (14A). When the pawl encounters a slot, it

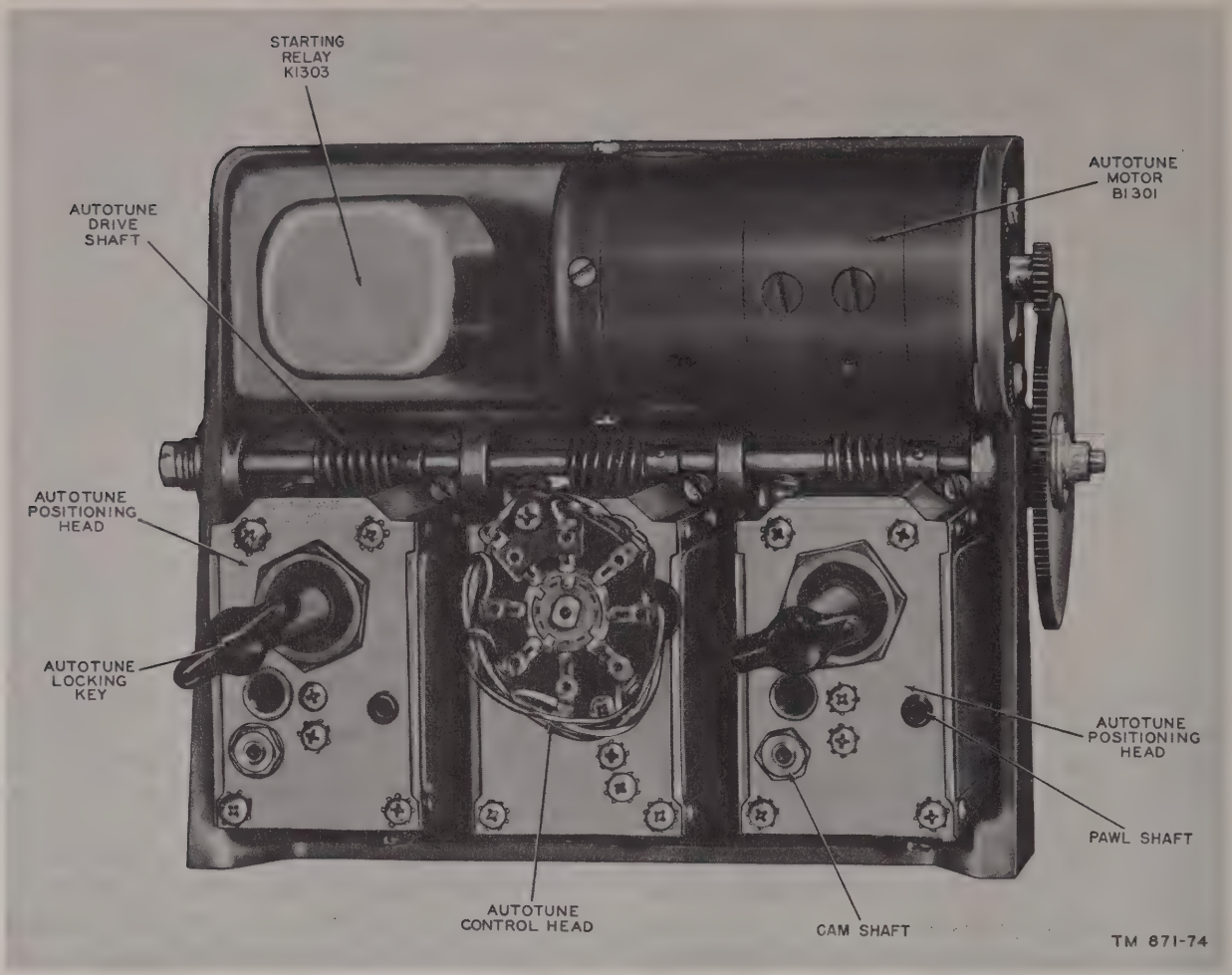

Figure 74. Antenna Coupler CU-286/FRR-33, Autotune assembly, front view.

falls into the slot until its toe (14C) presses against the stop ring (13). Since the stop-ring pawl heel (14A) is tapered, it rises out of the slot as the drum continues to rotate counterclockwise.

(2) While the friction clutch (4, 5, and 6) in each singleturn unit slips, motor B1301 continues to drive line shaft (1) and the seeking switch in the control head until the seeking switch encounters a "marked" position. Motor B1301 now reverses. Since the cam drum (11) and seeking switch are synchronized, the slot in the cam drum is in position to receive the pawl corresponding to a selected channel at the instant the motor reverses.

(3) When motor B1301 reverses the cam-drum ratchet (9 and 10) is disengaged and the cam drum (11) remains in the position corresponding to the channel setting. The stop rings (13) are now driven clockwise until the toe (14C) of the released pawl falls into the stop-ring slot, as shown in C of figure 76.

(4) After the stop ring engages the slot, the stationary stop ring prevents further rotation of the tuning shaft (17). The friction clutch (4, 5, and 6) slips until motor B1301 returns the control head shaft to its normal position and operates a limit switch to stop the motor.

(5) In the event that the selected channel has not been preset or is to be changed for reception on another frequency, the locking key (16) can be loosened by turning it counterclockwise approximately two revolutions. This releases pressure on the stop rings (13) and the tuning element (19) may be set to the desired position. After the tuning element is set to the desired position, the stop ring stack is locked, and all of the rings maintain their position

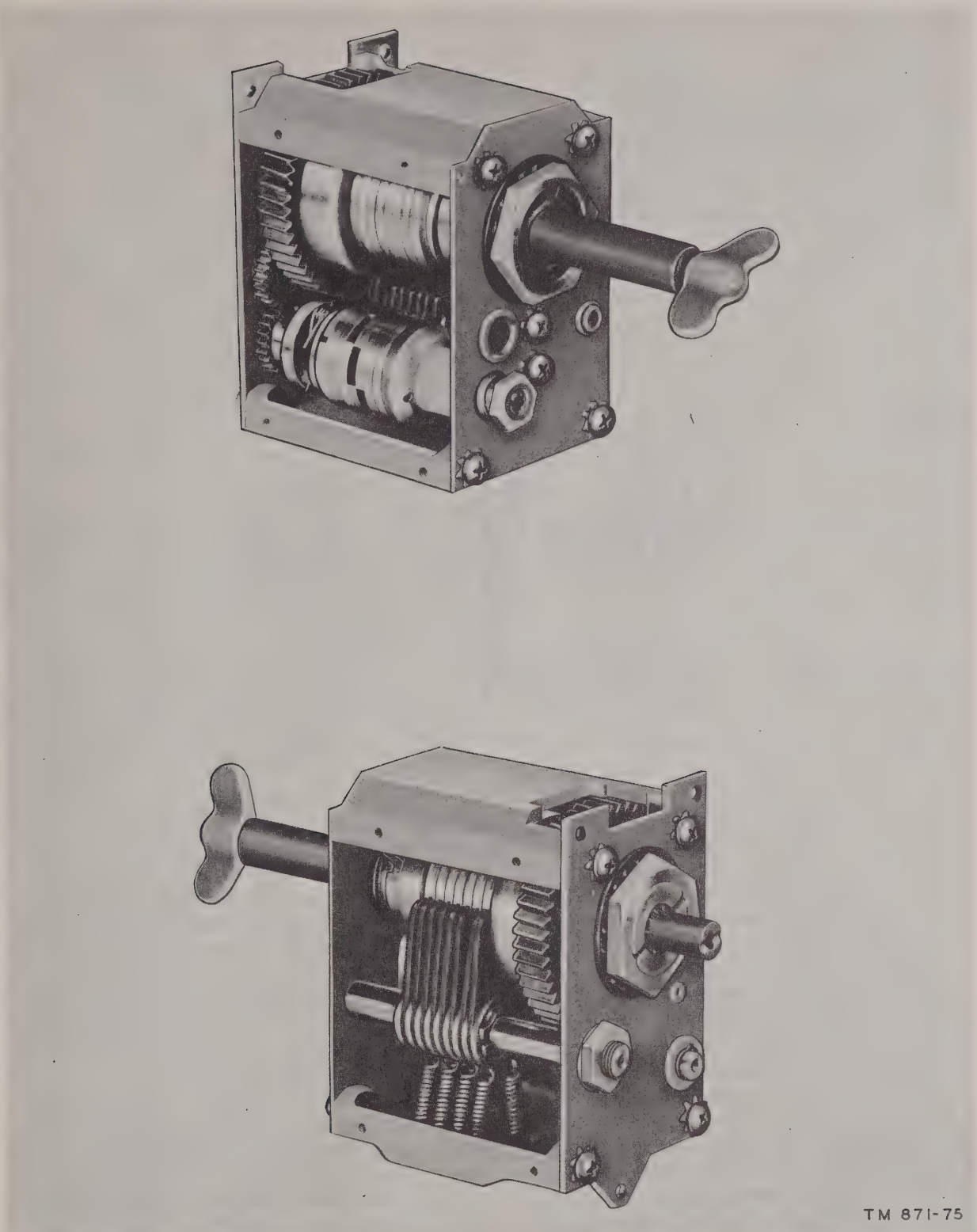

Figure 75. Autotune positioning head, front and rear views.

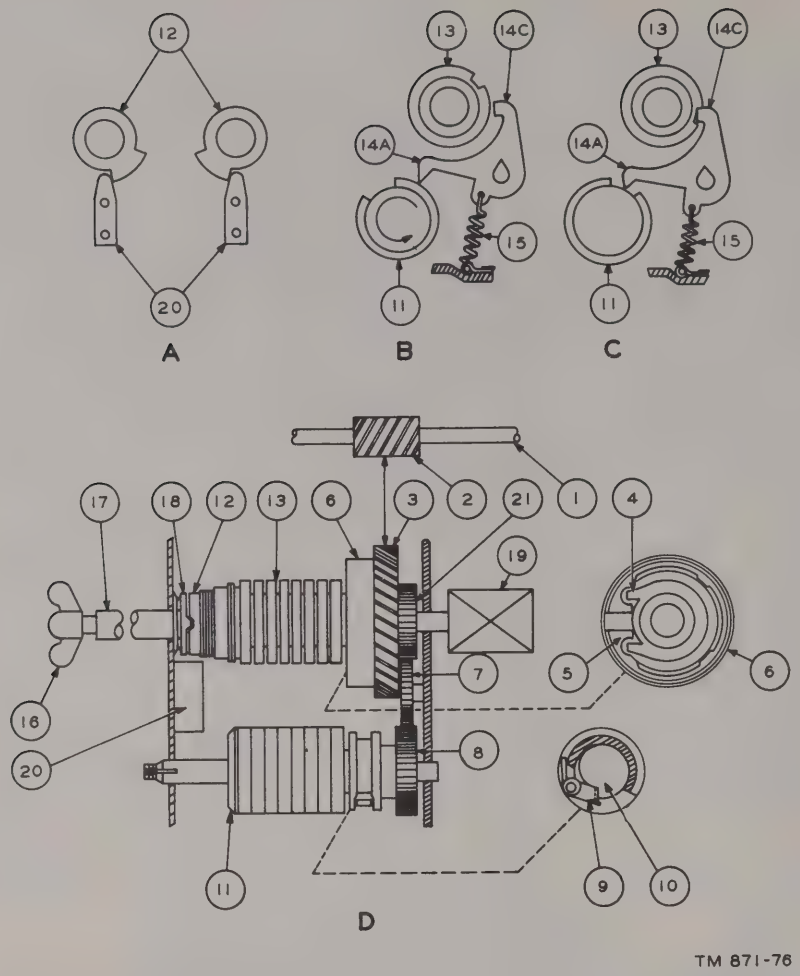

Figure 76. Autotune positioning head, functional diagram.

with respect to each other and the tuning element. Therefore, when the same channel is selected again, the tuning element will return to the same position.

b. When a channel is selected through operation of Selector Control C–974/FRR–33, a circuit is completed through contacts of switch S1405 in the selector control to ground a contact of seeking switch S1308. This circuit to ground completes a circuit for operating motor starting relay K1303. The motor actuates the tuning controls through the positioning head and, also, the switching circuits of the control unit. The control unit includes seeking switch S1308, starting relay K1303, timing switch S1307, reverse switch S1304, and limit switch S1305. The limit switch short-circuits the seeking switch to prevent stopping of the motor until it drives each tuning element to the limit of its range. When the tuning shafts are in an extreme counterclockwise position, the limit switch operates to remove the short circuit. Then, when the seeking switch encounters a marked contact to release starting relay K1303, the motor reverses to drive the tuning shafts in a clockwise direction. The position of the cam drum in each positioning head during the instant in which the motor reversed determines the selection of a specific preset channel.

(1) For example, channel 2 is selected by operation of the dial connected to Selector Control C–974/FRR–33. A circuit for operating starting relay K1303 is then completed from ground through contact 9 of plug P1350, contact G of receptacle J1351, contact G of receptacle J1465 of the selector control, contact 2 of Autopositioner switch S1405, contact B of receptacle J1465, contact B of receptacle J1351

of the antenna coupler, contact 2 of receptacle J1350, contact 2 of plug P1350, contact B of receptacle J1349, contact B of plug P1349, seeking switch S1308, normally closed contacts of limit switch S1305, contact N of plug P1349, contact N of jack J1349, winding of relay K1303, and through contact 13 of plug P1350 and jack J1350 to the +24-volt line. A simplified schematic for showing the relay operating circuit is shown in A of figure 77.

(2) Relay K1303 operates and closes the motor circuits. Circuits for operating the motor are shown in B of figure 77. Autotune motor B1301 is a shunt-wound motor. The direction of rotation is reversed by changing the polarity of the armature voltage. During the first half cycle of operation of the tuning system the direction of current flow through the armature winding is such to cause the motor to turn the tuning shafts counterclockwise (as viewed from the knob end). Each terminal of the armature winding is connected to the common contact of a double-pole double-throw set of contacts on relay K1303 to provide for reversal of the polarity of the voltage applied to the armature winding from the 24-volt supply. A circuit for the field winding is completed from ground, through the field winding, and through either a pair of normally open contacts on relay K1303 or the contacts of limit switch S1305 to the +24-volt supply.

(3) When the motor begins to rotate the tuning shafts counterclockwise, a switch actuator arm releases limit switch S1305 and it assumes the position shown in B of figure 77. Operation of the limit switch opens the circuit for operating relay K1303, but the relay now maintains an operating circuit from ground through reverse switch S1304 (also unoperated under these conditions), through closed contacts of relay K1303, and through the relay winding to 24-volt supply. In its new position limit switch S1305 prepares a circuit for applying voltage to motor B1301 after the relay releases to cause the motor to reverse. Before the tuning shafts have reached their complete counterclockwise positions, the original operating circuit for relay K1303 may be opened at the seeking switch when the notch in the rotor encounters the contact corresponding to the selected channel. However, until reverse switch S1304 operates, the relay circuit is maintained complete through the reverse switch contacts as described above.

(4) When the tuning shafts reach their extreme counterclockwise positions, the home-stop ring in each positioning head strikes its home-stop bar to stop the shafts, and the clutches in the positioning head slip while the motor continues to drive the seeking switch. Reverse switch S1304 is now operated by the switch actuator arm, and the circuit for K1303 opens when the notch in the rotor of seeking switch S1308 next encounters the grounded contact, the contact for channel 2 in this instance. The exact time for opening the relay circuit is determined by the opening contacts of timing switch S1307. More accurate timing is provided by using these contacts than by using seeking switch S1308. The timing switch contacts open at each position of the switch to remove a short-circuit across the seeking switch and to open the relay circuit provided the notch of the seeking switch is opposite the marked contact. When the cam drums of the positioning head are positioned for receiving pawls that determine selection of the desired channel the starting relay circuit is opened at that instant by contacts of the timing switch.

(5) When the operating circuit of the starting relay is opened the relay releases to reverse the polarity of the voltage applied to the motor armature. When the relay releases, contacts that originally connected the +24-volt terminal to the motor circuits are opened and the motor circuit is completed through contacts of limit switch S1305, as shown in C of figure 77. The motor reverses to drive the tuning shafts clockwise. The cam-drum ratchet in each positioning head is disengaged so that the heel of a pawl for the selected channel remains in a cam slot. The toe of the released pawl presses against its stop ring until it encounters a slot to stop the tuning shaft. After the tuning shaft of a positioning head stops, the friction clutch in the unit slips until limit switch S1305 is again operated by the actuator arm and the motor power circuit shown in C of figure 77 is broken. The control unit is again at its home position and remains there until a new channel is selected.

83. General

a. Radio Receiver R-391/URR provides for the reception of cw, mcw, am., and frequency-shift signals over a frequency range of .5 to 32 mc. The receiver is basically a superheterodyne of the multiple conversion type. Triple conversion is employed for the lower frequencies (.5 to 8 mc) and double conversion for the higher frequencies (8 to 32 mc).

b. The receiver normally operates from a self-contained power supply designed to operate at a nominal input of 115 or 230 volts over a frequency range of 48 to 62 cps.

c. The Autotune system of Radio Receiver R–391/URR operates on a nominal supply of 24 volts dc, as normally supplied by Power Supply PP–629/URR.

d. The tuning system of Radio Receiver R–391/URR provides linear tuning over the entire frequency range of the receiver. Permeability tuning (insertion of powdered-iron cores into coils) and a system of Autotune-driven gears and cams make possible linear tuning and the use of a counter-type indicator on the front panel to show the frequency selected.

84. Block Diagram
(fig. 78)

a. The block diagram shows the signal path from the antenna to the output. A schematic diagram (fig. 124) shows details of the circuits in the same order.

b. Power Supply PP–621/URR provides dc for the antenna and break-in relays, ac to the filament and oven circuits, and B+ voltage to the voltage-regulator circuit. All B+ voltages supplied to the receiver are regulated. The voltage-regulator circuit consists of series regulator V605 and V606, dc amplifier V607, and voltage-reference tubes V608 and V609. The power supply consists of a transformer, with two primary windings connected in series for 230-volt ac operation or connected in parallel for 115-volt ac operation and rectifiers V801 and V802. Dc voltage for the break-in relay circuits is provided by dry-disk rectifier CR801.

c. Rf signals are fed to the receiver from the antenna coupler. Antenna relay K101 grounds the antenna input for break-in operation and during calibration. This relay also operates to protect the antenna circuits of the receiver during standby operation. The rf signals pass through one of several antenna transformers (selection of which is determined by the operating frequency of the receiver) and are fed to the first rf amplifier V201.

d. The calibration oscillator subchassis, composed of V901 and V902, supplies a signal at every 100-kc point within the frequency range of the receiver. A 1000-kc crystal-oscillator stage, one-half of V901, provides a signal for synchronizing multivibrator stage V902 at 100 kc. A buffer-amplifier stage, one-half of V901, isolates the multivibrator from the loading effects of the rf circuit and increases the strength of the higher 100-kc. harmonics. When the FUNCTION switch is in the CAL position, B+ voltage enables the calibration oscillator circuits.

e. The output of first rf amplifier V201 is coupled to the grid of second rf amplifier V202. The gain of the first and second rf amplifiers is controlled manually by the RF GAIN control (not used in this system) and automatically by the automatic gain control voltage. These stages amplify the rf signals before applying them to the mixer circuits. The output of the second rf amplifier (.5 to 32 mc) is fed to either the first or second mixer, depending on the MEGACYCLE CHANGE control setting. For frequencies from .5 to 8 mc, the rf signal is mixed with the output of first crystal oscillator V401 in first mixer stage V203 to produce an if. signal which is variable in frequency from 9 to 18 mc. For frequencies from 8 to 32 mc, the rf signal is fed directly from the output of the second rf stage to second mixer V204. The heterodyning signal for this mixer is supplied from second crystal oscillator V402. The if. range of the second-mixer-output signal is 3 to 2 mc. It should be noted that the intermediate frequency at the output of the second mixer decreases as the input signal frequency increases. The input to third mixer V205 always has a frequency range of 2.5 to 2 mc. The output of vfo tube V701 is mixed with the input signal in the third mixer to produce a fixed frequency of 455 kc. The frequency range of the vfo is from 3.455 to 2.455 mc on all ranges of the receiver except the .5- to 1-mc range, in which case the upper frequency limit is 2.955 mc.

f. The 455-kc output signal of the third mixer is applied to the grid of first if. amplifier V501 either directly or through crystal filter Z501, depending on the bandwidth desired. For the two narrow pass bands, .1 and 1 kc, the crystal filter is used. Four additional degrees of selectivity which do not use the crystal filter are accomplished in the if. stages by the BANDWIDTH switch which varies the coupling between the primary and secondary circuits of the if. transformers. The if. amplifier consists of six stages, V501 through V506, which, together with the associated transformers, provide the required pass band. The output of fifth if. amplifier V505 is divided to supply a 455-kc signal to each of three stages:

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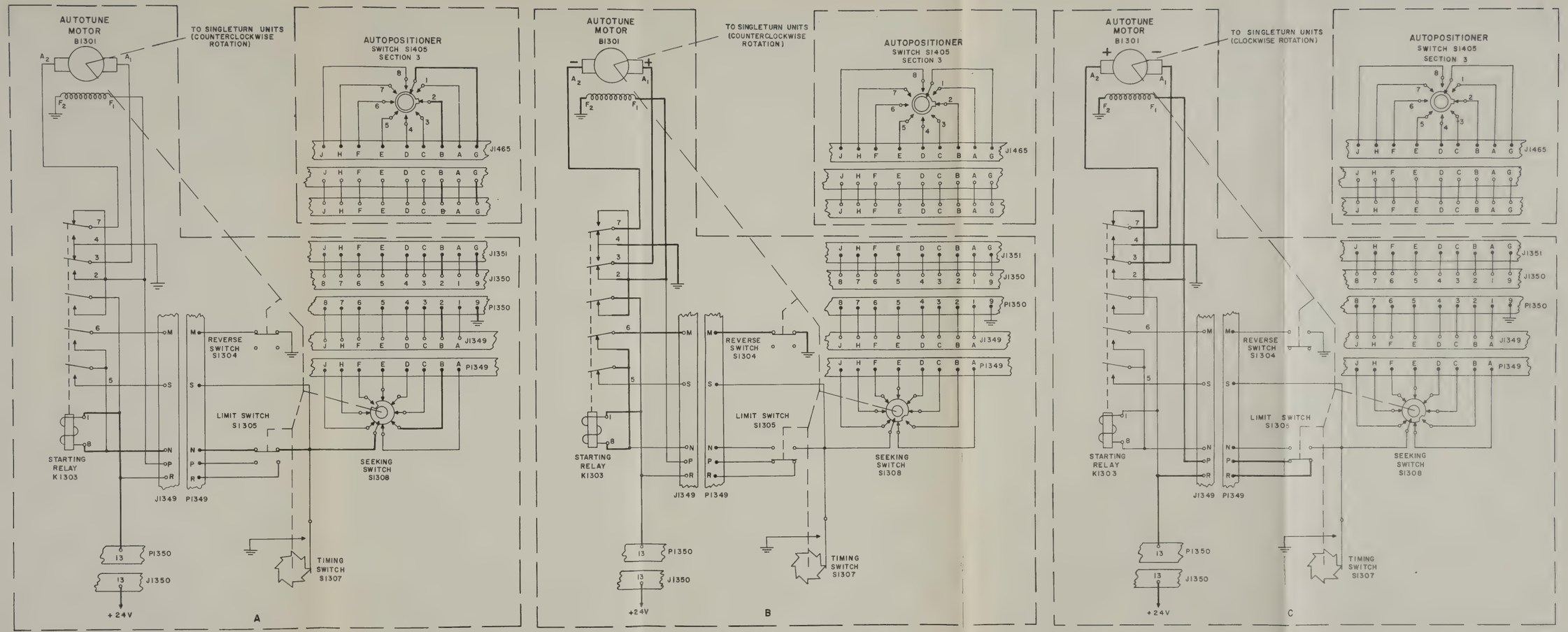


Figure 77. Autotune control circuit, schematic diagram.

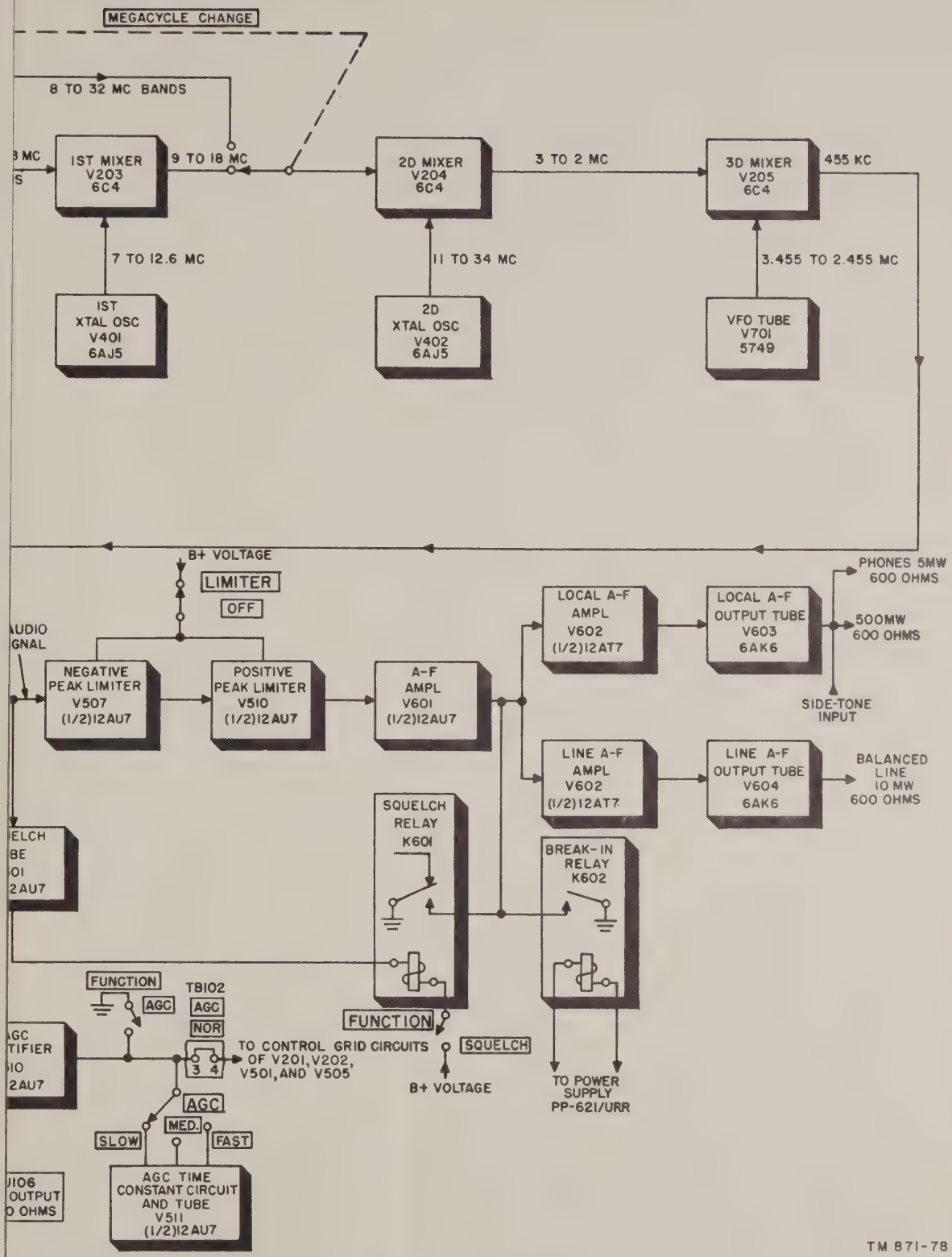


Figure 78. Radio Receiver R-391/URR, block diagram.

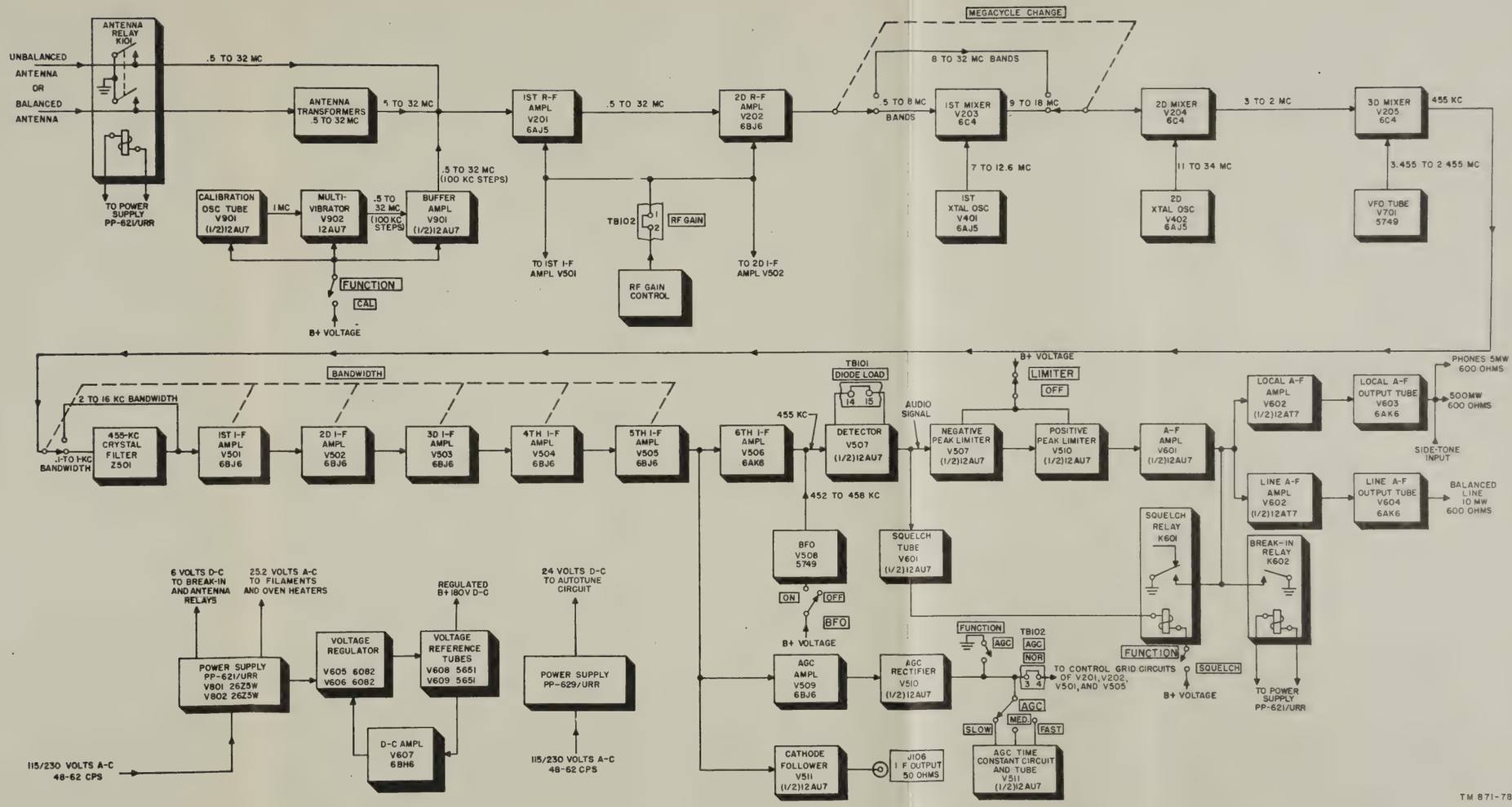


Figure 78. Radio Receiver R-391/URR, block diagram.

sixth if. amplifier V506, agc amplifier V509, and the cathode follower, one-half of V511. The output signal of the sixth if. amplifier is demodulated in the detector circuit, one-half of V507. An external diode load may be connected from DIODE LOAD terminal 14 ground with the jumper between terminals 14 and 15 removed. The output of the fifth if. amplifier is amplified in agc amplifier V509, and the resulting signal is rectified by agc rectifier, one-half of V510. When the FUNCTION switch is set for AGC operation, the gain of rf amplifiers V201 and V202 and of if. amplifiers V501 and V505 is controlled automatically by a dc voltage developed by the agc rectifier, one-half of V510, to keep the output level of the receiver relatively constant and independent of signal-strength variation at the antenna. Thus for strong signals the grid bias is high and the gain of the controlled stages is reduced and for weak signals a grid bias is reduced and gain of the controlled stages is increased. The response rate of agc circuits can be controlled to satisfy reception requirements through the use of the AGC switch, the agc time constant circuit, and one-half of tube V511. For MGC operation, the agc bus is grounded by the FUNCTION switch. The cathode follower, one-half of V511, provides a low-impedance connection (50 ohms) from the output of the if. stages for use when the receiver is employed for frequency-shift teletypewriter and single-sideband reception. To facilitate operation in the reception of radio telegraph signals, in certain system applications and in calibration, bfo tube V508 provides a signal in the frequency range of 452 to 458 kc. This signal is mixed with the 455-kc if. output signal of the sixth if. amplifier to produce a beat frequency in the output of the detector which is in the af range. The output of the detector, one-half of V507, is coupled to the af amplifier, one-half of V601 through a negative peak limiter, one-half of V507, and a positive peak limiter, one-half of V510 which prevent noise peaks from exceeding average signal level. If operation without limiting is desired, the limiters can be disabled by a front-panel control.

g. In addition to supplying signals to the limiter, the detector, one-half of V507, supplies a dc signal to the squelch tube, one-half of V601, which is a voltage amplifier. The average dc output voltage of the squelch tube varies in proportion to the the average signal level. When the signal level drops below some predetermined noise level established by the setting of the RF GAIN control and when the FUNCTION switch is set for SQUELCH operation (not used in this system), this voltage operates squelch relay K601, which short-circuits the output of the af amplifier V601 to quiet the receiver output. The output of the af amplifier can also be shorted to ground by break-in relay K602, when the FUNCTION switch is set to STAND BY, or to either MGC, AGC, or SQUELCH when the BREAK IN switch is set to ON and an external circuit provides a ground. The output from af amplifier, one-half of V601 is divided and applied through separate gain controls to a local af amplifier, one-half of V602. The output of the local af amplifier supplies signals to local af output tube V603, which has connections for a speaker or a headset and for sidetone signals from an associated transmitter to permit monitoring. The line af amplifier supplies signals to line af output tube V604, which has connections for a balanced line.

h. Power Supply PP–629/URR supplies 24 volts dc for operation of the Autotune system.

Section III. THEORY OF SELECTOR CONTROL C–974/FRR–33

85. Block Diagram
(fig. 79)

Selector Control C–974/FRR–33 performs the following functions: controls the tuning and switching circuits in the antenna coupler, controls the tuning and rf sensitivity circuits in the two receivers, and controls stand-by and disable circuits in various units. Tone impulses to operate the selector control may be received from a remote position or may be developed locally by operation of dial S1403, mounted on the front panel.

a. Incoming tone impulses from a 600-ohm balanced line are amplified by two af amplifier stages (V1401 and V1402A). The plate circuit of the first stage is tuned to the frequency (1,105 cps) of the controlling tones. The second amplifier is a resistance-coupled stage with a limiting grid circuit.

b. Amplified tone impulses are rectified by rectifier V1402B to form dc impulses. These dc impulses are applied to the control grid of impulsing relay control tube V1403 to operate impulsing relay K1401.

c. For local control the input of the second impulse amplifier is short-circuited to ground and local dial S1403 applies impulses directly to the control grid circuit of the impulsing control relay stage.

d. The impulsing relay applies each impulse to stepping relay K1402. The stepping relay includes several rotary switch sections. For each received impulse, the wipers of these sections advance one position. Interrupter contacts on the stepping relay apply impulses to slow release control tube V1404, which in turn operates function selector delay relay K1405. Because a time delay circuit prevents this relay from following individual im-

pulses the relay remains operated until impulsing ceases and the wipers of the switch sections have come to rest. When the relay releases after the wipers of the stepping relay have come to rest, circuits for controlling the selected function are completed through wiper contacts of the stepping relay and contacts of the function selector delay relay K1405. Normally closed contacts of Autotune muting relay K1403 provide the ground for relay K1402. Relay K1403 energizes when any of the Autotunes in the system operate, thus preventing operation of the selector control during tuning.

e. Contacts of selector disconnect relay K1406 are placed in the ground circuit of the bay selector section of relay K1402 to prevent selection of the proper bay until relay K1406 is de-energized. This prevents improper bay selection during homing operation.

f. Eight positions of the stepping relay switch sections are used for controlling an Autopositioner, which in turn operates Autotunes in various units to select a given channel. Other positions operate relays; one relay may be actuated to switch antennas and others may be actuated to obtain stand-by or disable conditions. Since two or three systems, or bays, may be operated from one remote position and means must be provided for selecting the bay to be controlled, three positions of the stepping relay switch sections are used for preparing the selected bay to receive controlling information. Other switch positions perform no useful function and the switch is automatically homed if numbers corresponding to these positions are dialed.

g. Selector Control C–974/FRR–33 also contains a power supply for providing regulated plate voltage and a 24-volt source for relay windings. The plate supply contains a 5Y3WGT rectifier tube and three tubes in a voltage regulator circuit. The 24-volt supply includes a dry-disk rectifier and filter capacitors.

86. First Impulse Amplifier
(fig. 80)

a. Tube V1401 uses a miniature type pentode in a conventional circuit to provide amplification of 1,105-cycle impulses from Remote Switching Control C–973/FRR-33. Tone selectivity is provided by a tuned plate circuit.

b. Control grid bias for the first impulse amplifier is determined by the voltage developed across unbypassed cathode resistor R1404. The plate and screen grid obtain operating voltage from a common decoupled supply. This decoupling is provided by resistor R1412 (fig. 81) and capacitor C1401. Voltage to the plate is applied through inductor L1401. Screen grid operating voltage is obtained through voltage-dropping resistor R1405. Capacitor C1402 bypasses ac signal to ground.

c. Interrupted tone from Remote Switching Control C–973/FRR–33 is applied through af input transformer T1401 and a level control circuit to the control grid of a type 6AU6 tube in the first impulse amplifier stage. A 600-ohm line from the remote position is connected to terminals 3 and 6 of the split primary winding of transformer T1401. Terminals 4 and 5 of the transformer are either connected together or connected to a circuit for

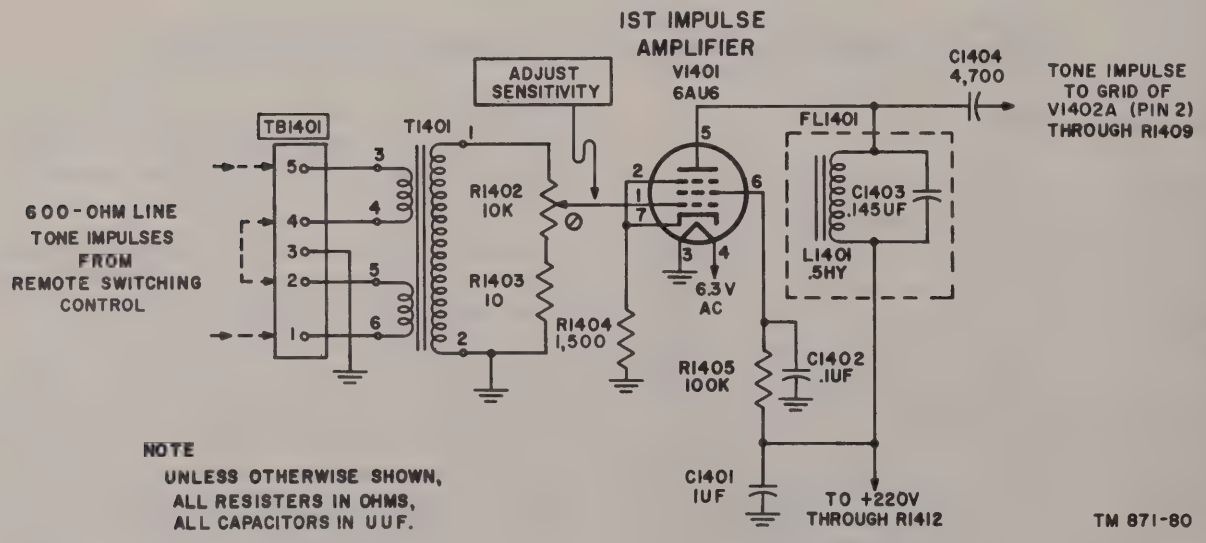
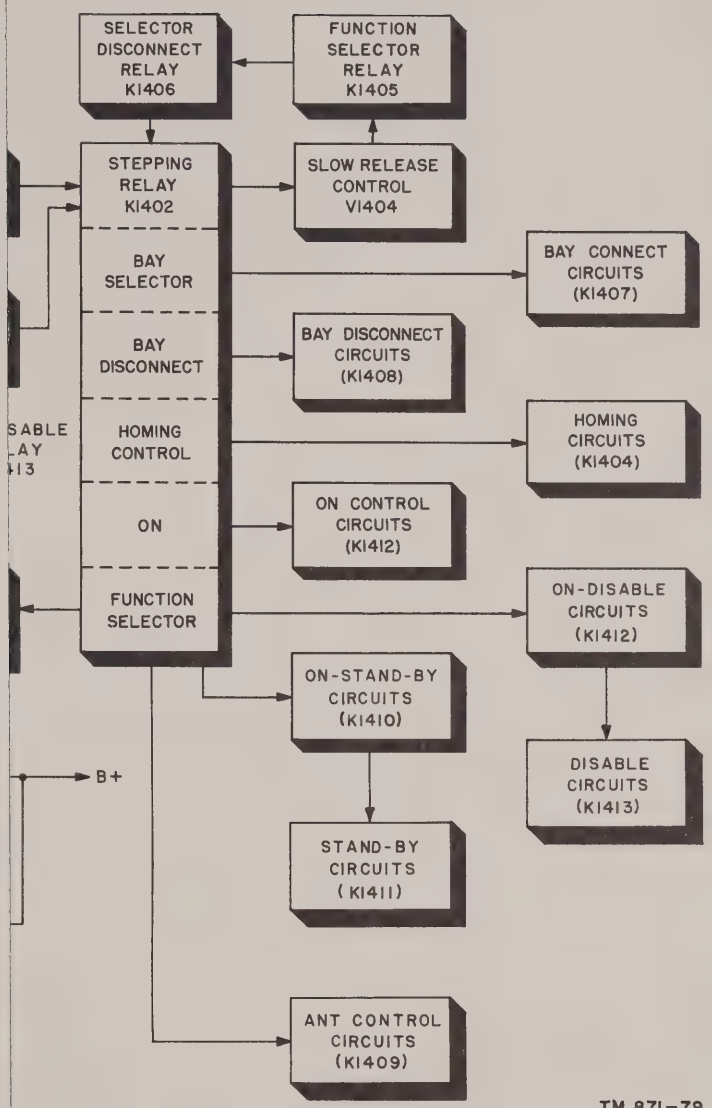


Figure 80. Selector Control C-974/FRR-33, first impulse amplifier, schematic diagram.



ntrol C-974/FRR-33, block diagram.

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86. First Impulse Amplifier
(fig. 80)

a. Tube V1401 uses a miniature type pentode in a conventional circuit to provide amplification of 1,105-cycle impulses from Remote Switching Control C–973/FRR-33. Tone selectivity is provided by a tuned plate circuit.

b. Control grid bias for the first impulse amplifier is determined by the voltage developed across unbypassed cathode resistor R1404. The plate and screen grid obtain operating voltage from a common decoupled supply. This decoupling is provided by resistor R1412 (fig. 81) and capacitor C1401. Voltage to the plate is applied through inductor L1401. Screen grid operating voltage is obtained through voltage-dropping resistor R1405. Capacitor C1402 bypasses ac signal to ground.

c. Interrupted tone from Remote Switching Control C–973/FRR–33 is applied through af input transformer T1401 and a level control circuit to the control grid of a type 6AU6 tube in the first impulse amplifier stage. A 600-ohm line from the remote position is connected to terminals 3 and 6 of the split primary winding of transformer T1401. Terminals 4 and 5 of the transformer are either connected together or connected to a circuit for

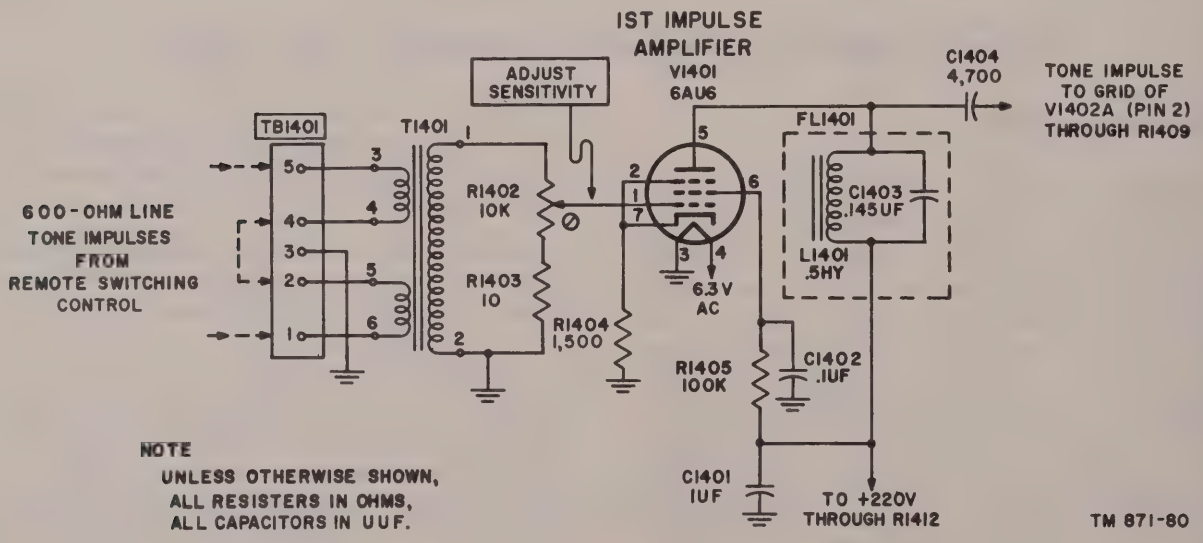


Figure 80. Selector Control C-974/FRR-33, first impulse amplifier, schematic diagram.

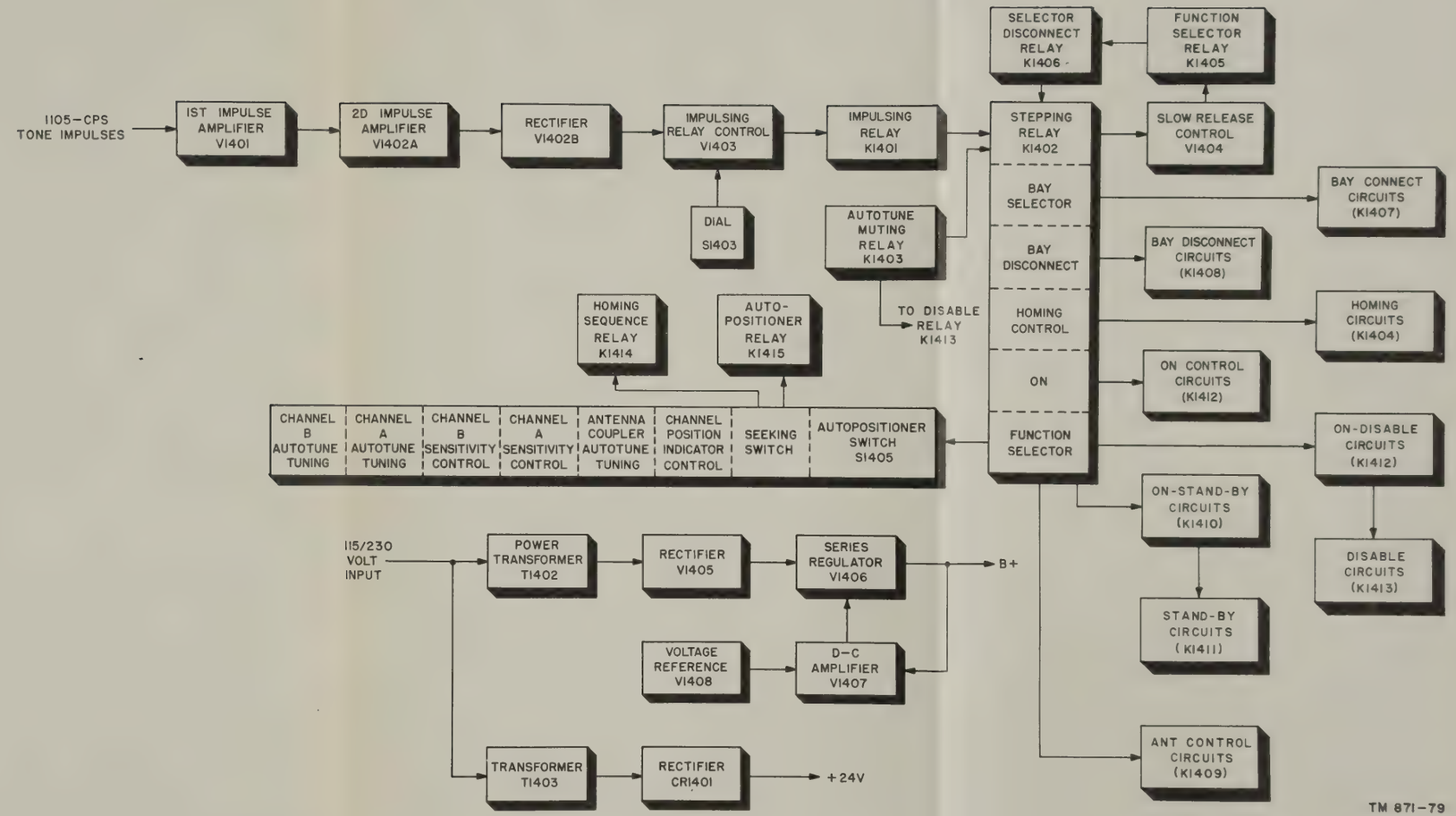


Figure 79. Selector Control C-974/FRR-33, block diagram.

balancing the line with respect to ground. Voltage from the tone impulses is induced into the secondary winding of T1401 and applied to potentiometer R1402 and resistor R1403. Signal voltage from the arm of the potentiometer is applied to the control grid of tube V1401. In order to increase the voltage applied to the control grid the ADJUST SENSITIVITY control R1402 is turned clockwise. With sensitivity set too low, stepping relay K1402 will not operate. With too much sensitivity, overloading occurs and the selectivity of the parallel-tuned circuit in the plate of tube V1401 is reduced, so that stepping relay K1402 will not follow impulses. The plate load of tube V1401 consists of a parallel-tuned circuit (FL1501). This parallel circuit is tuned to 1,105 cps to obtain maximum plate load impedance and maximum gain at this frequency. Signal voltage developed across FL1501 is coupled through capacitor C1404 to the grid circuit of the second impulse amplifier.

87. Second Impulse Amplifier
(fig. 81)

The second impulse amplifier, using one section of a 12AX7 duo-triode, amplifies weak impulses and limits strong positive impulses. The grid circuit contains two 1-megohm resistors (R1408 and R1409) connected in series from grid to ground. Signal from the preceding stage is applied to the junction of these resistors. Control grid bias is developed across cathode resistor R1411. When the peak signal voltage applied to the grid circuit through C1404 is more positive than the control grid bias, grid current flows through resistor R1409, develops a voltage in opposition to the positive signal voltage, and prevents any appreciable increase of voltage applied to the control grid. Plate voltage is applied through resistor R1412 and plate load resistor R1410 to the plate. Signal voltage developed across plate load resistor R1410 is applied through capacitor C1405 to the rectifier circuit.

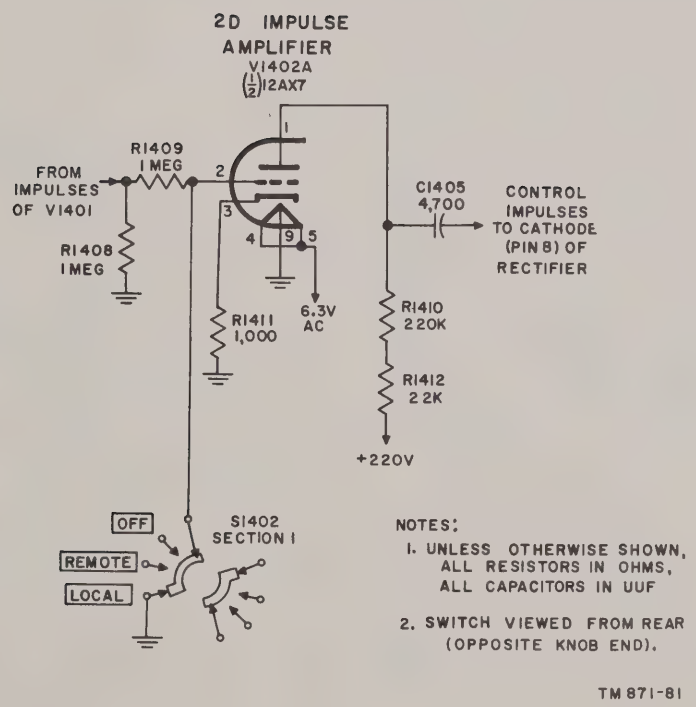


Figure 81. Selector Control C-974/FRR-33, second impulse amplifier, schematic diagram.

When OFF-REMOTE-LOCAL switch S1402 is in the LOCAL position the second impulse amplifier is disabled, since the control grid is connected to ground through the contacts of section 1 of the switch.

88. Rectifier and Impulsing Relay Control
(fig. 82)

a. Signal from the second impulse amplifier is rectified to form dc impulses. These impulses are applied to a dc amplifier, V-1403, to operate impulsing relay K1401.

b. One triode section of tube V1402 is operated with the plate and grid connected for diode operation. Tone impulses are applied from the plate of the second impulse amplifier through coupling capacitor C1405 to the cathode of the rectifier and to the control grid of impulsing relay control stage V1403. The impulsing relay control stage uses a type 6AK6 pentode tube to operate impulsing relay K1401. Grid resistor R1413 and the diode rectifier are connected in parallel to form a circuit from control grid to ground. Since the diode rectifier conducts only when the cathode is negative with respect to the plate, the effect of the diode is to shunt the 1-megohm grid resistor, R1413, with a low impedance during negative portions of the cycle. This steepens the trailing edge of the positive tone impulse to give a more positive action of the impulses applied to the control grid of tube V1403. Positive impulses on the control grid cause the plate current of tube V1403 to increase and operate impulse relay K1401. A grid biasing arrangement in the cathode circuit insures sufficiently low plate current between impulses to allow relay K1401 to release. The biasing circuit consists of resistors R1414, R1415, and R1416 connected from B+ to ground. The bias voltage is developed across resistors R1415 and R1416. Bleeder current develops sufficient voltage from cathode to ground to maintain plate current at cutoff except when a positive impulse is applied to the control grid. The screen grid is connected directly to the output of the power supply; the winding of the impulsing relay is connected from the same output to the plate of V1403. Capacitor C1406 is connected across the relay winding to filter any 1,105 cps rectified tone appearing in the plate circuit of tube V1403.

c. When switch S1402 is in LOCAL position the impulse amplifier is disabled to prevent operation of the impulsing relay from a remote station. Local dial S1403 is connected to provide dc impulses directly to the impulse relay control tube. Impulse voltage is derived from a voltage divider, consisting of resistors R1417 and R1418, connected from B+ to ground. The junction of these resistors is connected through contacts of switch S1402 to the control grid of the impulsing relay control tube. Dial S1403 is also connected from the junction of the resistors to ground. Normally the dial contacts are closed, short-circuiting resistor R1418, and the control grid of V1403 is grounded. When the dial is operated the contacts open momentarily and remove the short circuit across resistor R1418. The number of times the contacts open corresponds to the digit dialed. Whenever the dial contacts open, positive voltage developed across resistor R1418 is applied to the control grid of impulsing relay control tube V1403 to operate impulsing relay K1401.

d. The impulsing circuits may also be operated from an external relay or dial that has normally closed contacts. When the OFF-REMOTE-LOCAL switch is in REMOTE position and the EXT-INT switch (located on rear of chassis) is in EXT position, the external contacts are connected in a circuit identical to the circuit used with dial S1403. Impulsing voltage is obtained from the voltage divider consisting of resistors R1406 and R1407 (fig. 123).

89. Slow Release Control Stage
(fig. 83)

Slow release control stage V1404 utilizes a type 6C4 triode in a circuit to prevent selector circuits in the selector control from functioning while impulsing occurs. Under normal conditions the function selector delay relay K1405 is not operated, since the tube is biased below cut-off. Bias is obtained from a bleeder circuit consisting of resistors R1421 and R1422 connected from B+ to ground. A parallel circuit including resistor R1420 and capacitor C1408 is connected from grid to ground. One contact of the normally open contacts of stepping relay K1402 is also connected to the grid. The other contact is connected to the junction of series resistors R1423 and R1424. These resistors are connected between B+ and ground. When stepping relay K1402 operates, the positive voltage developed across resistor R1424 is applied to the grid of V1404. This positive voltage is sufficient to overcome the bias on the tube and plate current flows, operating function selector delay relay K1405. While the relay is operated and its contacts are open, the function circuits through the wiper contacts of K1402 are open. This relay operates only once for each train of impulses and remains operated for an interval after impulsing has stopped. This is caused by the time delay circuit of resistor R1420 and capacitor C1408. Each time the contacts in the grid circuit close the capacitor charges, and when the contacts open it discharges slowly through resistor R1420, maintaining positive voltage on the control grid sufficient to keep plate current flowing for a short time.

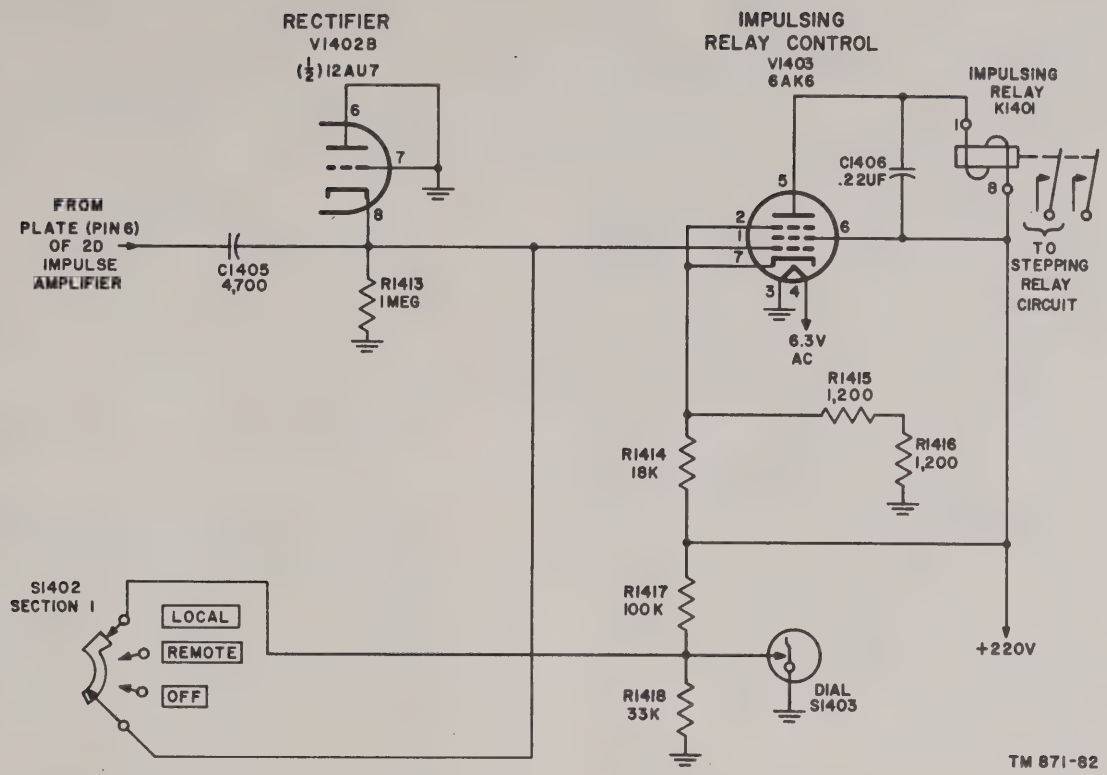


Figure 82. Selector Control C-974/FRR-33, rectifier and impulsing relay control, schematic diagram.

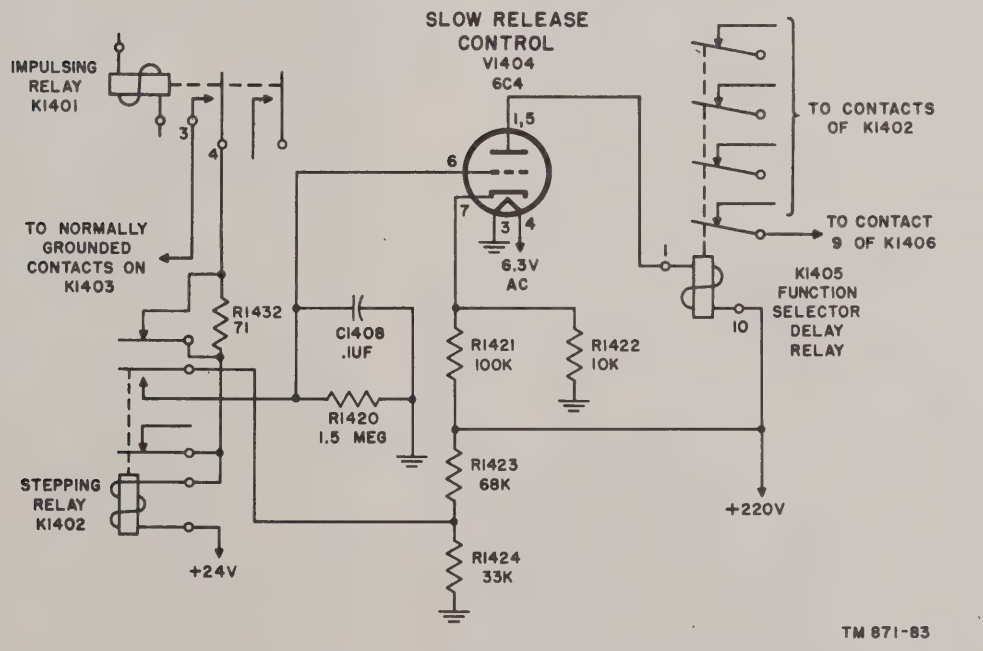


Figure 83. Selector Control C-974/FRR-33, slow release control stage, schematic diagram.

90. Local Channel Selection
(fig. 126)

Local selection of a channel may be accomplished by the following sequence of operations. The selection of channel 4 will be discussed, but all channels follow a similar sequence of operations. Switch S1402 is placed in the LOCAL position and channel 4 is dialed. As the dial returns to the normal position its contacts open momentarily four times to cause the impulsing relay K1401 to operate four times in rapid succession as described in paragraph 88. For each impulse, the operating circuit of stepping relay K1402 is closed momentarily through contacts 3 and 4 of the impulsing relay. (The ground return for the operating circuit also includes normally closed contacts of Autotune muting relay K1403.) Capacitor C1407 and resistor R1419 are connected in series from contact 4 to ground to provide an arc-suppression circuit. In the energized position of relay K1402 a pair of normally closed contacts open, removing the short circuit across current-limiting resistor R1432. This resistor must be shorted initially in order to obtain proper operating current for relay K1402. Once energized, the current requirements to maintain operation are reduced. The following operations then occur:

a. Stepping relay K1402 advances the wipers of its switch sections four positions.

b. As soon as the wipers move from the home, or normal, position, a set of off-normal springs (section 7) on K1402 close and remain closed as long as the wipers are in an operated position. These contacts prepare a locking circuit for homing relay K1404.

c. A pair of normally closed contacts operate with each impulse. These contacts are interrupter contacts for homing the stepping relay and are not connected in a complete circuit until controlling operations are completed.

d. A pair of normally open contacts operate with each impulse. These contacts apply impulses of positive voltage to the control grid of the slow release control tube V1404. This causes the function selector delay relay in the plate circuit of V1404 to operate. Operation of this relay prevents closing of function circuits through the wipers of relay K1402 while the wipers are being rotated to the desired position.

e. The stepping relay reaches position 4 and stops. Function selector delay relay K1405 now releases.

f. The release of relay K1405 closes a circuit for operating homing-sequence relay K1414 and Autopositioner relay K1415. The circuit for operating these relays is closed through contacts of seeking switch S1405 (section 1), contact 4 of section 2 of K1402, contacts 8 and 9 of K1405, contacts 2 and 3 of K1406, and contacts on section 2 of OFF-REMOTE-LOCAL switch S1402.

g. Autopositioner relay K1415 contacts close and complete the circuit for Autopositioner motor B1401. The motor operates until the slot in the rotor of section 1 of switch S1405 moves opposite the contact for position 4. The circuit for relay K1415 then opens, which in turn opens the motor circuit and it ceases to rotate.

h. With switch S1405 in position 4 the following circuits are closed:

(1) Section 2 of the switch completes a circuit to light the channel 4 indicator lamp on the front panel.

(2) Section 3 marks a position for operating the Autotune in Antenna Coupler CU–286/FRR–33.

(3) Sections 4 and 5 complete circuits for determining the rf sensitivity of each receiver for channel 4.

(4) Sections 6 and 7 mark positions for operating Autotunes in Radio Receivers R–391/URR.

i. At the same time the circuit for Autopositioner relay K1415 opens, the circuit for homing-sequence relay K1414 also opens. A circuit for homing relay K1404 is then completed through contacts 2 and 11 of relay K1414, position 4 contacts of section 3 of K1402, contacts 6 and 7 of relay K1405 and the winding of the homing relay.

j. Homing relay K1404 operates and closes a locking circuit through contacts 2 and 3, through off-normal springs of K1402, and through contacts 4 and 5 to ground. This locking circuit insures operation of the stepping relay until home position is reached.

k. With the homing relay locking circuit in operation the following occurs:

(1) The circuit for operating the stepping relay is completed through contacts 4 and 5 of the homing relay, through the off-normal springs, and through interrupter contacts of the stepping relay. When this circuit is completed, an armature and a pawl for operating the wipers are operated against the tension of an armature spring, and the pawl advances one position to a different ratchet tooth. This closes the normally open contacts of K1402 and function selector delay relay K1405 operates. As explained in paragraph 89, this disconnects the wipers of the switch sections during rotation. As the armature is attracted, the interrupter springs are opened to de-energize the winding. The armature spring then returns the armature and advances the wipers one step. The interrupter springs are closed again and the stepping relay continues to step until the wipers

reach the home position.

(2) At the same time a circuit is closed through contacts 4 and 5 of the homing relay to operate selector-disconnect relay K1406. This relay opens the circuit to the wiper of sections 2 and 6 of K1402 before the homing action rotates the switch to a different set of contacts. Possible selection of an undesired function and bay is thus prevented.

l. When the wipers reach normal position the operating circuit for the homing relay is opened both at the off-normal springs and at section 3 of K1402. The homing relay releases and opens the interrupter circuit.

m. Selector disconnect relay K1406 releases and prepares the function selector circuit for selection of a different function.

91. Remote Channel Selection

In the event that channel 4 is to be selected from a remote position, OFF-REMOTE-LOCAL switch S1402 is placed in REMOTE position. Section 1 of this switch removes the ground from the control grid of the second impulse amplifier and disconnects local dial S1403 (fig. 126). Section 2 of this switch prepares a circuit to home stepping relay K1402 in the event that a wrong prefix number is dialed. To prepare a particular Selector Control C–974/FRR–33 for reception of controlling information from a remote position, a prefix number must be dialed just prior to the dialing of the number of the selected function. The setting of switch S1404 determines which one of three numbers, 07, 08, or 00, is to be dialed as a prefix number. The switch may, for example, be set at 07.

a. When 07 is dialed a series of 10 and a series of 7 impulses are transmitted through amplifier and rectifier circuits described above and the wipers of relay K1402 are positioned on contacts 07. When impulsing stops, the function selector delay relay releases and closes a circuit for bay connect relay K1407. This circuit extends from ground through contacts 14 and 9 of relay K1406, contacts 2 and 3 of relay K1405, section 6 of K1402, contacts of switch S1404, to the winding of bay connect relay K1407. Operation of relay K1407 closes a locking circuit from ground through its contacts 3 and 11, and through contacts 11 and 2 of bay disconnect relay K1408; prepares a circuit for grounding the wiper of section 2 of K1402; and opens a circuit at its contacts 13 and 7 to prevent homing of the stepping relay before a change in channel or function is accomplished. Also, when function selector delay relay K1405 releases after impulsing stops, a circuit for operating the homing relay is completed through contacts of K1405 and section 3 of stepping relay K1402. Bay connect relay K1407 remains operated, but the stepping relay is returned to the home position. Channel 4 is now dialed and the circuit operates as described previously. The circuit for operating the Autopositioner relay K1415, however, is now completed through contacts 5 and 12 of bay connect relay K1407, and not through contacts of switch S1402.

b. Bay disconnect relay K1408 also operates and opens the circuit of bay connect relay K1407. Although relay K1408 may operate after impulsing has stopped, regardless of local or remote control, it is effective only during remote operation. The circuit for operating relay K1408 is completed from ground through contacts of homing sequence relay K1414, contacts of section 5 of K1402, contacts 4 and 5 of relay K1405, and to the winding of relay K1408. Operation of relay K1408 opens the locking circuit of bay connect relay K1407.

(1) Relay K1407 remains operated for a short time after the locking circuit is opened. The delay results from the discharge of capacitors C1414 and C1415 through the relay winding.

(2) The occurrence of this time delay after a channel or function has been selected is incidental, but the delay is required when the stepping switch starts to home after a prefix number is dialed.

(3) For example, when the stepping switch starts to home after dialing 07, the wiper of section 5 of this switch may encounter the contact for 08 before function selector delay relay K1405 operates. The circuit is then momentarily completed to operate bay disconnect relay K1408. If it were not for the time delay in the operation of K1407, momentary action of bay disconnect K1408 would release relay K1407 before the number for changing channel or function is dialed.

c. In the event 08 is dialed from a remote position to prepare circuits for another Selector Control C–974/FRR–33, the wipers of the stepping switch in the selector control set for prefix number 07 will home immediately and no function is performed through the operation of this switch. This occurs because the circuit for operating bay selector relay K1407 is open and, therefore, the function selector circuit is also open. If 07 is dialed just before 08 and bay selector relay K1407 operates, a circuit is completed through section 5 of K1402 to operate bay disconnect relay K1408. Operation of relay K1408 insures the release of bay connect relay K1407.

d. When the OFF-REMOTE-LOCAL switch is in REMOTE position and any number other than a prefix

number or 0 is dialed for a first digit, a circuit for operating the homing relay after impulsing has stopped is completed from ground through contacts 2 and 3 of relay K1405, through contacts of section 6 of K1402, through 14 and 9 of relay K1406, through contacts of switch S1402, through contacts 7 and 13 of relay K1407, and through the homing relay winding to the 26-volt supply. Operation of the homing relay causes the stepping switch to return to its normal position.

92. Selection of Functions
(fig. 126)

Note. Refer to paragraph 75 for further information on selection of functions.

a. STANDBY control is provided by dialing 06. After relay K1402 completes 16 steps and function selector delay relay K1405 releases, a circuit is completed through contacts of section 2 of switch S1402 (local control) or through contacts of bay connect relay K1407 (remote control), contacts 2 and 11 of relay K1406, contacts 8 and 9 of relay K1405, 06 contact of section 2 of K1402, and through the stand-by control relay K1410 winding to the 24-volt supply. Relays K1409, K1410, and K1412 each have two windings and two stable positions. After an impulse of current through one winding operates the armature and spring contact to one position, the relay remains in that position until current flows through the other winding. After the stand-by control winding of relay K1410 receives a current impulse, the relay contacts are in the position shown in figure 66. Contacts 9 and 10 complete a circuit for operating stand-by relay K1411, contacts 12 and 13 complete a circuit for lighting STANDBY lamp I 1404, and contacts 7 and 8 complete a circuit to operate homing relay K1404 (fig. 126). Contacts 7 and 8 also complete a circuit through section 5 of K1402 to operate bay disconnect relay K1408. (Operation of relay K1408 to release bay connect relay K1407 is effective when the circuits are controlled from a remote position.) Operation of relay K1411 opens the plate voltage circuit of Antenna Coupler CU–286/FRR–33, closes the break-in relay circuits of Radio Receivers R-391/URR, and disables Radioteletype Terminal Equipment AN/FGC–1 ( ).

b. DISABLE controls are similar to STANDBY controls. The disable control relay winding is energized by dialing 03. When its armature operates contacts close to operate DISABLE lamp I 1405, disable relay K1413, homing relay K1404, and bay disconnect relay K1408. Operation of disable relay K1413 closes contacts to place Radioteletype Terminal Equipment AN/FGC–1 ( ) in the steady *mark* position. Unlike the STANDBY condition, the radio receiving set remains operative in the disable condition. This allows the operator to check various functions of the radio receiving set without operating the terminal equipment.

c. Radio Receiving Set AN/FRR–33 is turned ON from the DISABLE or STANDBY positions by dialing 05. After the wipers of stepping relay K1402 reach position 05, a circuit to energize the on-control winding of stand-by control relay K1410 is completed through section 2 of K1402, and a circuit to energize the on-control winding of disable control relay K1412 is completed through section 4 of K1402. One of the relays will operate, depending upon the previous selection of either stand-by or disable. In either case, a circuit now exists to operate homing relay K1404 and bay disconnect relay K1408. This circuit is completed through contacts 6 and 7 of relay K1410 and through sections 3 and 5 of relay K1402.

d. To select antennas in Antenna Coupler CU–286/FRR–33 either 01 or 02 is dialed. The number selected depends upon the position of the antennas at the time of selection. The position of the armature of antenna control relay K1409 depends on which of the two numbers was last dialed. Contacts 12, 13, and 14 control relay circuits in Antenna Coupler CU–286/FRR–33 to switch antenna input circuits, and contacts 9, 10, and 11 control antenna indicator lamps (I 1402 and I 1403) on the front panel of the selector control. Bay disconnect and homing control circuits are completed through contacts 7 and 8 when ANT 2 is selected, or through contacts 6 and 7 when ANT 1 is selected.

e. If it is desirable to change a dialing sequence after starting the sequence, this can be accomplished by dialing 9, CLEAR. This completes a circuit from ground, through contact 9 of section 3 of relay K1402, through contacts 7 and 6 of relay K1405 to operate homing relay K1404. At the same time, a circuit is completed from ground, through contact 9 of section 5 of relay K1402, through contacts 5 and 4 of relay K1405 to operate bay disconnect relay K1408.

93. Power Supply

The power supply used in Selector Control C–974/FRR–33 is similar to that used in Antenna Coupler CU–286/FRR–33. The regulated plate voltage circuit, containing V1405, V1406, V1407, and V1408, uses tubes and components identical to those used in the antenna coupler. In this case, however, the B+ adjust potentiometer R1430 is set to give a 220-volt output. A discussion of the circuit operation is given in paragraph 79. Supply voltage for relay operation is obtained from a 26-volt cir-

cuit consisting of transformer T1403, rectifier CR1401, and filter capacitors C1412 and C1413. A schematic diagram of the power supply may be found in figure 126.

94. Autopositioner System

a. General. To provide automatic selection of the channels in the radio receiving set from either a remote or local position, the equipment is provided with an Autopositioner rotary positioning system. The operation of the Autopositioner completes control circuits to operate the various Autotune units in the equipment and set up the selected channel.

b. Components. An Autopositioner is a motor-driven rotary positioning mechanism providing automatic selection of any one of a given number of positions, each function being a fixed function of the switch combination of the system. The basic elements of the Autopositioner, as shown in figure 84, consist of a motor and its gear reduction train, a slip clutch, a rotary shaft to which is fastened a notched stop-wheel, a pawl which engages the notches of the stop-wheel, and a solenoid which actuates the pawl and also operates a set of electrical contacts to start and stop the motor. Associated with the Autopositioner unit is an electrical control system consisting of a selector switch actuated by channel selection functions and a rotary seeking switch driven by the Autopositioner shaft. This control system is of the "open-circuit seeking" type, designed so that whenever the selector switch is in one of the channel positions and the seeking switch is not in the same channel position the Autopositioner unit is energized and operates to drive its shaft (and the driven elements to which it is coupled) to the proper position to restore the symmetry of the control system.

c. Cycle of Operation (fig. 84). The cycle of operation of the Autopositioner is as follows:

(1) The system is at rest with the selector switch at home position and the seeking switch in the previous channel position. The solenoid is de-energized, the pawl engages a stop-wheel notch, and the motor is de-energized.
(2) The operator selects a new channel.
(3) The selector switch operates to provide a ground at the selected channel contacts on the selector switch.
(4) This energizes the solenoid, thus lifting the pawl out of the stop-wheel notch and closing the motor control contacts.
(5) The motor starts, driving the Autopositioner shaft and the rotor of the seeking switch.
(6) The seeking switch reaches a position corresponding to the selected channel. A slot in the rotor exists at this position and the control cir-

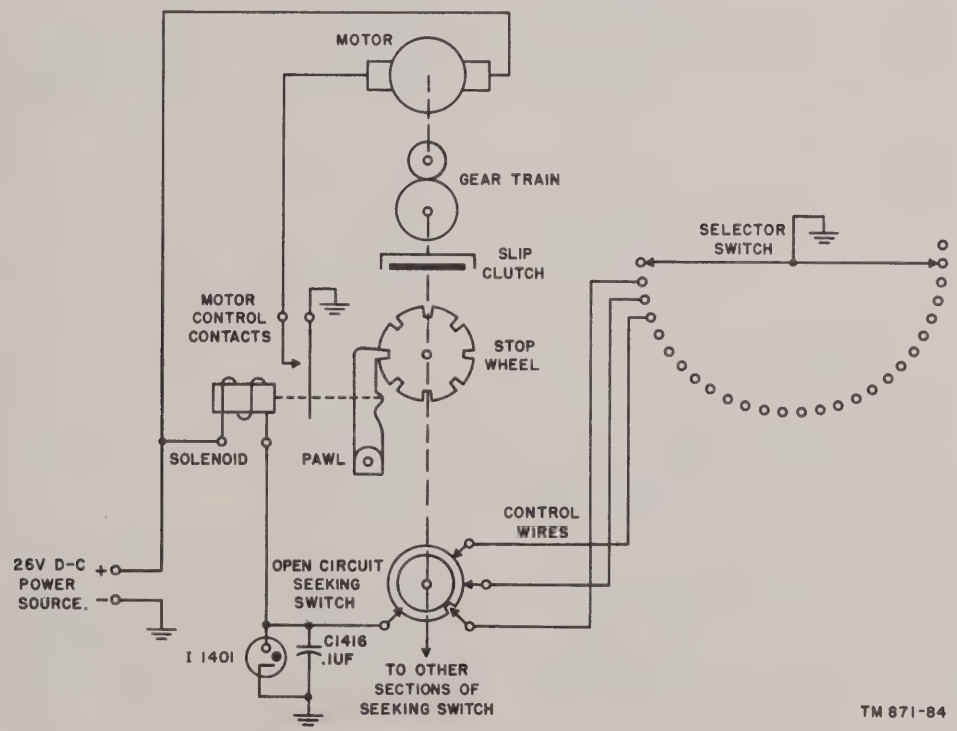


Figure 84. Selector Control C-974/FRR-33, Autopositioner system, functional diagram.

cuit is broken. The solenoid de-energizes and permits the pawl to drop into the corresponding stop-wheel notch to stop shaft rotation.

(7) The motor control contacts open and the motor coasts to a stop, dissipating its kinetic energy in the slip clutch.

d. Seeking Switch. The seeking switch of the control circuit is adjusted to open the relay circuit shortly before the stop-wheel reaches the point where the pawl engages the proper notch. The relay contacts controlling the motor are mechanically operated by the pawl arm so that they do not open until the pawl does drop into the notch. Neon lamp I 1401 and capacitor C1416 are connected in parallel between the rotor of the seeking switch and ground to suppress contact arcing.

e. Control Switches. Note that the Autopositioner system performs no actual tuning function in the equipment. Three rotary switches mounted on the same shaft as the seeking switch complete circuits to operate Autotune units in the receivers and antenna coupler. The Autotune units perform the actual tuning functions. Three other rotary switches on the same shaft complete circuits to light a channel indicator lamp and select the proper channel A and B adjust sensitivity controls in the antenna coupler.

Section IV. THEORY OF RECEIVER CONTROL C–975/URR

95. General

Receiver Control C–975/URR provides circuits to maintain automatic frequency control of the audio frequencies used in a frequency-shift keyed radioteletype system with an 850-cycle shift. The two channels are completely separate, but the power supply and metering circuit are common. Since the receiver control is normally used with extremely stable receivers, the receiver control functions chiefly to minimize and correct for tuning errors in the transmitter and errors to drift in the transmitter frequency. The signal path for channel A is shown in figure 85. A complete schematic diagram is given in figure 124.

96. Block Diagram

a. If. output of the receiver is applied to the receiver control input receptacle. A single stage of if. amplification (V1501) is used and the resultant signal is applied to a signal detector (V1502A). Here it is mixed with the output of a bfo (V1509) operating at a normal frequency of 457.125 kc; with a 455-kc input signal, the resultant 2,125-cps signal is coupled to the receiver.

b. Audio voltage developed in the detector is also applied to a cathode follower (V1502B) that provides proper matching for the band-pass filter (FL1501). Output of the cathode follower is applied to the band-pass filter. The filter has an approximate center frequency of 2,125 cps and a band-pass range of approximately 1,750 through 2,500 cps. Note that the band-pass filter excludes the space frequency of 2,975 cps. Audio voltage developed across the filter load resistor is amplified by two a-f stages (V1504 and V1505) and applied to the input of a discriminator circuit.

c. The discriminator (V1507) is adjusted to operate with a center frequency of 2,125 cps. With a 455-kc signal input to the receiver control, the discriminator output is zero. When the input signal is above or below 455 kc, a negative or positive voltage, respectively, is obtained in the discriminator output. The amplitude of the negative or positive voltage depends on the excursion of the input signal from a center frequency of 455 kc.

d. The dc output voltage of the discriminator controls the bias on a reactance tube (V1508), which in turn controls the operating frequency of the bfo. With zero dc bias on the control grid of the reactance tube, the bfo operates at 457.125 kc. When the input signal to the receiver control varies from 455 kc, the detector output varies from 2,125 cps, resulting in a dc control voltage at the output of the discriminator, which acts to change the operating frequency of the bfo and shift the audio frequency output of the detector toward 2,125 cps.

e. The if. input signal applied to the signal if. amplified is also applied to a hold relay control circuit. The if. input is amplified by two if. stages (V1510 and V1511) and applied to another detector (V1512A) to give a dc control voltage that is applied to the relay control tube (V1512B). A relay in the plate circuit of the relay control stage controls the operation of the afc hold relay (K1501), thus controlling the output of the discriminator.

f. The bias of the first if. amplifier is controlled by the AFC THRESHOLD potentiometer. When the input signal is of sufficient amplitude to overcome the bias on the first if. amplifier, the signal is amplified and controls the afc discriminator circuit as just described. When the signal level is below the threshold level, the discriminator circuit cannot function and no dc control voltage is developed to apply to the reactance tube control grid. However, several capacitors and a resistor are connected in the

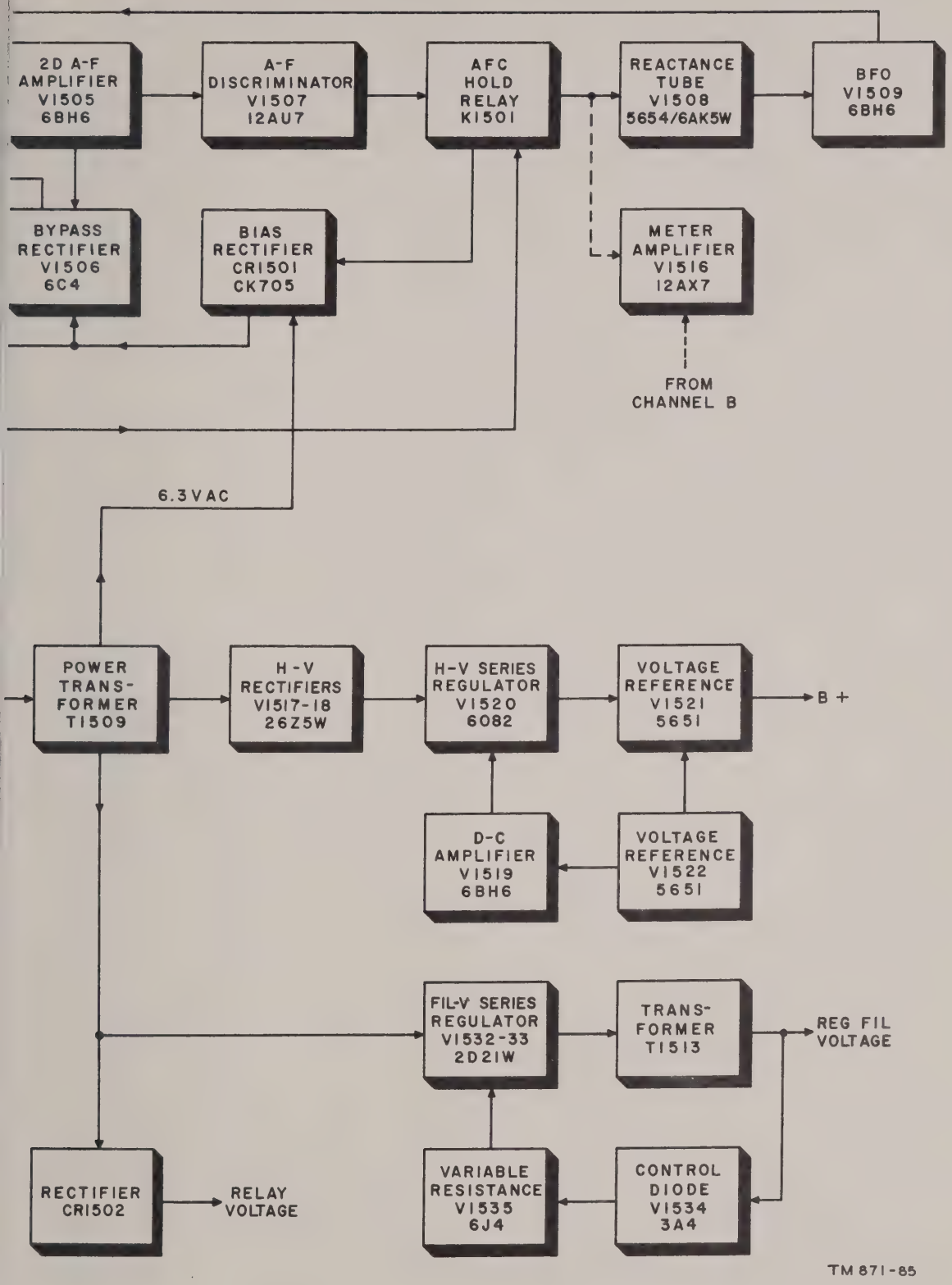


Figure 85. Receiver Control C-975/URR, block diagram.

cuit is broken. The solenoid de-energizes and permits the pawl to drop into the corresponding stop-wheel notch to stop shaft rotation.

(7) The motor control contacts open and the motor coasts to a stop, dissipating its kinetic energy in the slip clutch.

d. Seeking Switch. The seeking switch of the control circuit is adjusted to open the relay circuit shortly before the stop-wheel reaches the point where the pawl engages the proper notch. The relay contacts controlling the motor are mechanically operated by the pawl arm so that they do not open until the pawl does drop into the notch. Neon lamp I 1401 and capacitor C1416 are connected in parallel between the rotor of the seeking switch and ground to suppress contact arcing.

e. Control Switches. Note that the Autopositioner system performs no actual tuning function in the equipment. Three rotary switches mounted on the same shaft as the seeking switch complete circuits to operate Autotune units in the receivers and antenna coupler. The Autotune units perform the actual tuning functions. Three other rotary switches on the same shaft complete circuits to light a channel indicator lamp and select the proper channel A and B adjust sensitivity controls in the antenna coupler.

Section IV. THEORY OF RECEIVER CONTROL C–975/URR

95. General

Receiver Control C–975/URR provides circuits to maintain automatic frequency control of the audio frequencies used in a frequency-shift keyed radioteletype system with an 850-cycle shift. The two channels are completely separate, but the power supply and metering circuit are common. Since the receiver control is normally used with extremely stable receivers, the receiver control functions chiefly to minimize and correct for tuning errors in the transmitter and errors to drift in the transmitter frequency. The signal path for channel A is shown in figure 85. A complete schematic diagram is given in figure 124.

96. Block Diagram

a. If. output of the receiver is applied to the receiver control input receptacle. A single stage of if. amplification (V1501) is used and the resultant signal is applied to a signal detector (V1502A). Here it is mixed with the output of a bfo (V1509) operating at a normal frequency of 457.125 kc; with a 455-kc input signal, the resultant 2,125-cps signal is coupled to the receiver.

b. Audio voltage developed in the detector is also applied to a cathode follower (V1502B) that provides proper matching for the band-pass filter (FL1501). Output of the cathode follower is applied to the band-pass filter. The filter has an approximate center frequency of 2,125 cps and a band-pass range of approximately 1,750 through 2,500 cps. Note that the band-pass filter excludes the space frequency of 2,975 cps. Audio voltage developed across the filter load resistor is amplified by two a-f stages (V1504 and V1505) and applied to the input of a discriminator circuit.

c. The discriminator (V1507) is adjusted to operate with a center frequency of 2,125 cps. With a 455-kc signal input to the receiver control, the discriminator output is zero. When the input signal is above or below 455 kc, a negative or positive voltage, respectively, is obtained in the discriminator output. The amplitude of the negative or positive voltage depends on the excursion of the input signal from a center frequency of 455 kc.

d. The dc output voltage of the discriminator controls the bias on a reactance tube (V1508), which in turn controls the operating frequency of the bfo. With zero dc bias on the control grid of the reactance tube, the bfo operates at 457.125 kc. When the input signal to the receiver control varies from 455 kc, the detector output varies from 2,125 cps, resulting in a dc control voltage at the output of the discriminator, which acts to change the operating frequency of the bfo and shift the audio frequency output of the detector toward 2,125 cps.

e. The if. input signal applied to the signal if. amplified is also applied to a hold relay control circuit. The if. input is amplified by two if. stages (V1510 and V1511) and applied to another detector (V1512A) to give a dc control voltage that is applied to the relay control tube (V1512B). A relay in the plate circuit of the relay control stage controls the operation of the afc hold relay (K1501), thus controlling the output of the discriminator.

f. The bias of the first if. amplifier is controlled by the AFC THRESHOLD potentiometer. When the input signal is of sufficient amplitude to overcome the bias on the first if. amplifier, the signal is amplified and controls the afc discriminator circuit as just described. When the signal level is below the threshold level, the discriminator circuit cannot function and no dc control voltage is developed to apply to the reactance tube control grid. However, several capacitors and a resistor are connected in the

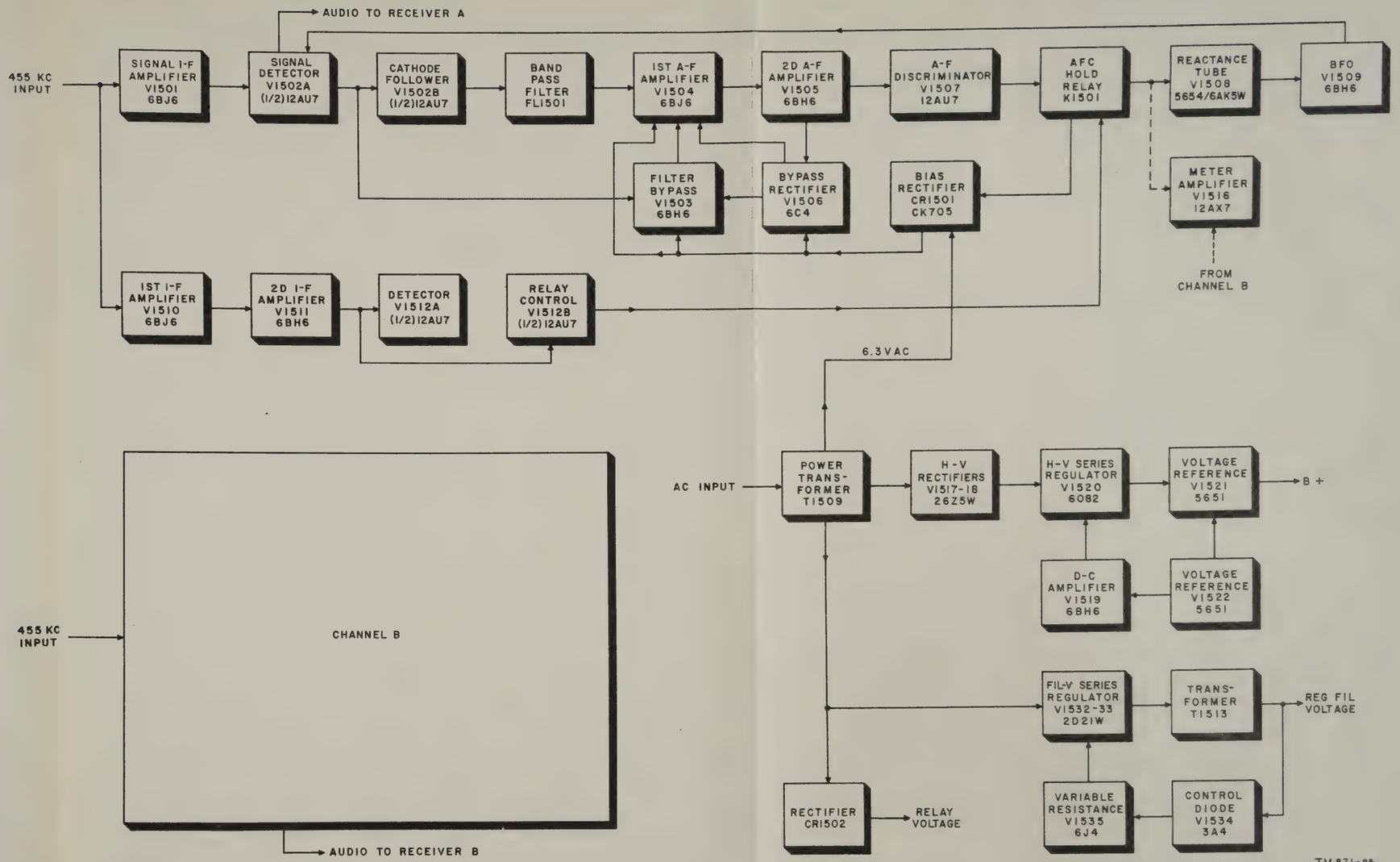


Figure 85. Receiver Control C-975/URR, block diagram.

grid circuit of the reactance tube. The time constant of this network is very long; the previous charge on the capacitors, determined by the action of the discriminator while the signal level is above threshold level, leaks off very slowly through the large effective discharge resistance of the network. This maintains a dc control voltage on the control grid of the reactance tube for some time after the signal level fades below threshold level. The resultant bfo drift under these conditions will be less than 150 cps per minute.

g. With normal 455-kc input, the output of the detector (2,125 cps) is coupled through the band-pass filter circuit and the audio amplifiers to the input of the discriminator. Audio voltage developed in the plate circuit of the second af amplifier also is coupled to the plate of bypass rectifier V1506. A negative dc voltage is developed by the operation of this tube. This negative voltage is used to bias filter bypass tube V1503 below cutoff and the tube cannot function. A portion of the negative voltage is also applied to the control grid of the first af amplifier to provide some avc.

h. When the input signal drifts not more than several hundred cycles in frequency, audio voltage sufficient to operate the bypass rectifier still is developed in the plate circuit of the second af amplifier and the filter bypass rectifier remains biased to cutoff. Discriminator output, however, is not zero. A dc output results as described in subparagraph *d* above. This control voltage varies the reactance-tube bias. Changing the bias varies the effect of the reactance tube on the bfo tank circuit. The bfo operating frequency changes and the resultant audio frequency developed in the detector plate shifts toward 2,125 cps. The af signal can only seek a 2,125 cps reference, since at that frequency the discriminator output is zero and the bfo operates at 457.125 kc. This obviously cannot be true, since the bfo is shifting in frequency to correct for an input error. Therefore, a small error in the af signal must exist when the afc circuit functions.

i. When the input frequencies drift until the af signal falls outside of the range of the band-pass filter, audio voltage developed in the plate circuit of the second af amplifier is insufficient to overcome the fixed bias of the bias rectifier. This removes the source of voltage biasing the filter bypass stage to cutoff and the tube is free to conduct. The af signal developed in the plate circuit of the signal detector then is amplified in the filter bypass stage and applied directly to the first af amplifier grid, thus bypassing the band-pass filter. The afc circuit then functions to shift the af signal back toward 2,125 cps. As soon as the af signal frequency falls within the range of the band-pass filter, the filter bypass tube again is biased to cutoff and the circuit functions as described above.

j. When the input signal level falls below the threshold level as determined by the AFC THRESHOLD control, the afc hold relay control circuit does not function and afc hold relay K1501 is de-energized. 6.3 volts ac is applied to the cathode of rectifier CR1501 through contacts 4 and 12 of relay K1501. Rectifier CR1501 conducts and develops a negative voltage across its load resistors. This negative voltage is then applied to the control grid of filter bypass tube V1503 and the tube is biased below cutoff. Therefore, noise voltages are prevented from operating around the band-pass filter and causing errors in the afc circuits.

k. The dc control voltages developed by the discriminator also are used to vary the bias on meter amplifier tube V1516. A microammeter in the plate circuits of the two triode sections of tube V1516 reflect these voltage changes. The meter is calibrated to give the approximate correction in kilocycles provided by the afc circuit.

l. The power supply of the receiver control consists of three sections, as follows:

(1) A six-tube circuit provides a regulated 180 volts for screen and plate voltages. Most of the tubes in the equipment also obtain their source of 6.3 volts for filament operation from this section.

(2) A four-tube circuit provides a regulated 6.3 volts for filament operation. The only stages in the equipment using this regulated filament voltage are the reactance tube and beat-frequency oscillator of each channel.

(3) Voltage to operate the afc hold relays is obtained from a separate bridge rectifier circuit.

Section V. THEORY OF POWER SUPPLY PP–629/URR

97. General

Power Supply PP–629/URR provides a 24-volt dc voltage with provision to operate the negative terminal either grounded or ungrounded. The power supply circuit consists of power transformer T1101 and full-wave bridge rectifier CR1101.

98. Circuit Analysis
(fig. 86)

The primary circuit of transformer T1101 consists of two primary windings, contacts A and D of power input receptacle J1131, 10-ampere fuses F1101 and F1102, ON-OFF switch S1102, and 115/230-volt switch S1101. Toggle switch S1101 must be placed in the position corresponding to the supply voltage. The toggle switch handle is retained by a bracket to prevent accidental placement of the switch in the wrong position. Two screws hold the bracket in place and may be loosened to shift the position of the switch handle and bracket. The two primary windings are connected in parallel for 115-volt operation and in series for 230-volt operation. The secondary voltage is applied to full-wave bridge rectifier CR1101 to obtain a 24-volt pulsating dc voltage. Several taps are placed on the transformer secondary winding to provide a minimum of 21 volts and a maximum of 26 volts with rated full-load output current of 17 amperes. A 28-volt pilot lamp I 1101 and current-limiting resistor R1101 are placed in series across the output to indicate on-off operation of the power supply. Dc voltage is taken from output receptacles J1133, J1134, and J1135 and from terminals B and C of output receptacle J1132 and power input receptacle J1131. Ac voltage is available at terminals A and D of output receptacle J1132. The negative side of the dc voltage supply can be operated at ground potential by a jumper across negative and ground terminals of terminal board TB1101. (If necessary, the positive side of the voltage supply may be operated at ground potential by a jumper across the positive and ground terminals of terminal board TB1101.)

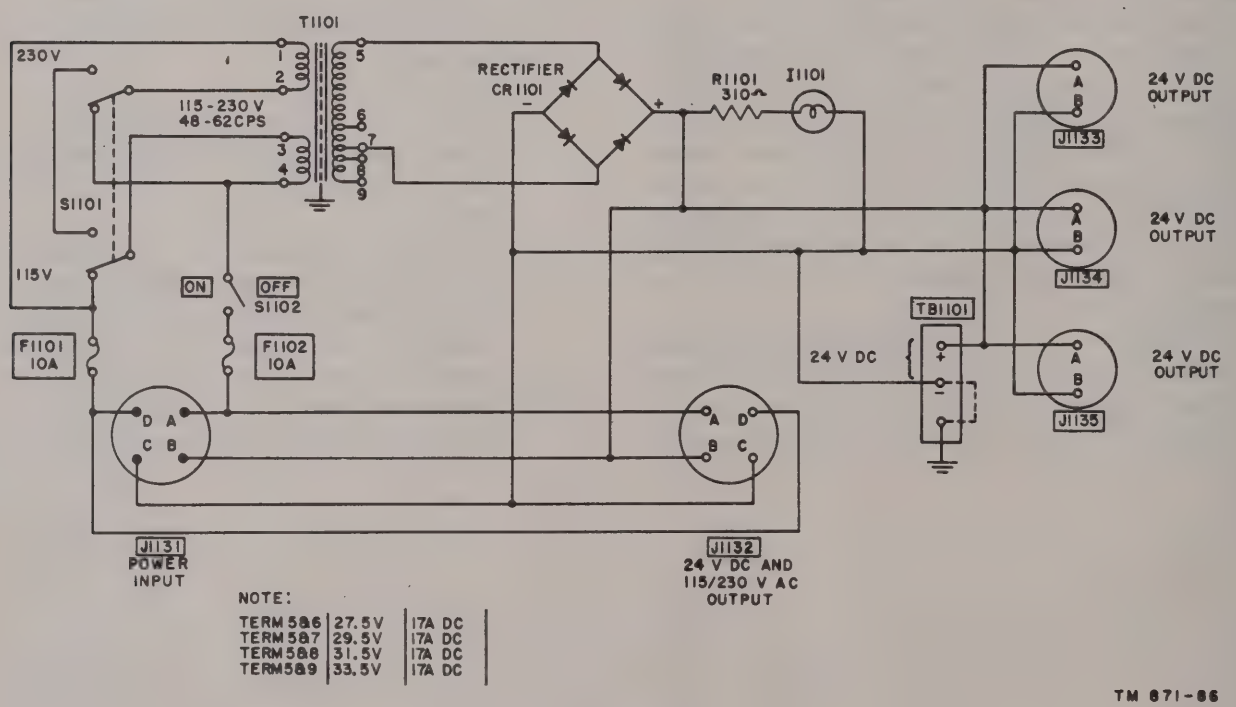


Figure 86. Power Supply PP-629/URR, schematic diagram.

Section VI. THEORY OF REMOTE SWITCHING CONTROL C–973/FRR–33

99. Block Diagram
(fig. 87)

Remote Switching Control C–973/FRR–33 supplies audio tone impulses for controlling one to three Radio Receiving Set AN/FRR–33 equipment bays. The af oscillator generates a 1,105-cps signal. Operation of the telephone-type dial allows impulses of the audio tone to be applied to the af amplifier stage. These tone impulses are amplified and applied to a 600-ohm balanced line. EXT TONE-INT TONE switch S1202 may be operated from the rear of the switching control equipment to transfer the dial interrupter springs from the internal oscillator circuit to an external circuit. In the EXT TONE position the center tap of inductor L1201 is grounded and af oscillator V1201 will not function. At the same time the dial interrupter springs are connected to contacts of terminal board TB1205 for connection to the external circuit to be controlled. Plate and filament voltage are supplied by a power supply within the remote switching control. The plate supply voltage is maintained constant by a voltage regulator circuit.

100. Af Oscillator
(fig. 88)

a. Tone impulses to control a radio receiving set from a remote position are produced by af oscillator V1201. The af oscillator uses a miniature type 6AK6 in a Hartley circuit arrangement.

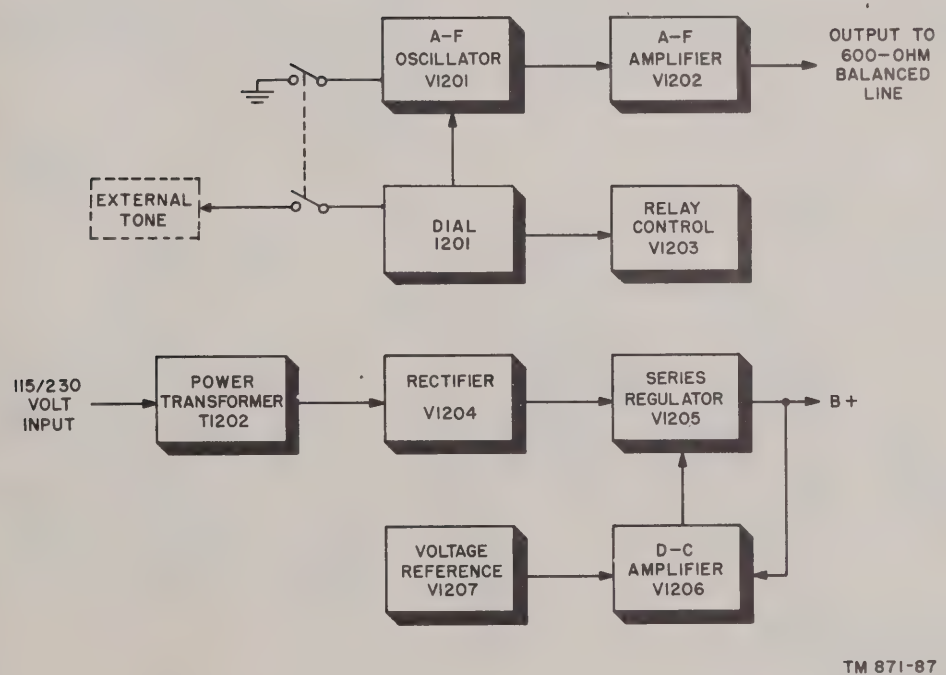


Figure 87. Remote Switching Control C-973/FRR-33, block diagram.

b. Under static conditions the center tap of grid inductor L1201 is grounded to prevent oscillations. Negative bias for the control grid is developed across cathode resistor R1202. The plate and screen grid are connected together and obtain operating voltage through voltage-dropping resistor R1203. C1204 acts as a bypass to ac voltages that may appear on the plate or screen grid.

c. A resonant circuit, consisting of tapped iron-core inductor L1201 and parallel capacitors C1201 and C1202, determines the operating frequency of the oscillator. The frequency is maintained within 25 cycles of 1,105 cps. One end of inductor L1201 is connected through blocking capacitor C1203 to the control grid of tube V1201. The other end is grounded. A tap on inductor L1201 is connected to the cathode return to provide inductive coupling between cathode and grid circuits. While the circuit is oscillating, additional grid bias is developed across grid leak resistor R1201 through flow of rectified grid current. When INT TONE-EXT TONE switch S1202 is in the INT TONE position and dial S1201 is in its normal position terminal 2 of inductor L1201 is connected to ground through pulsing contacts to prevent oscillation. As the springs are operated by dialing to remove the ground, 1,105 cps tone impulses are generated by the oscillator. The number of impulses is equal to the number, or digit, dialed. Oscillator output is coupled through capacitor C1205 to the grid circuit of tube V1202.

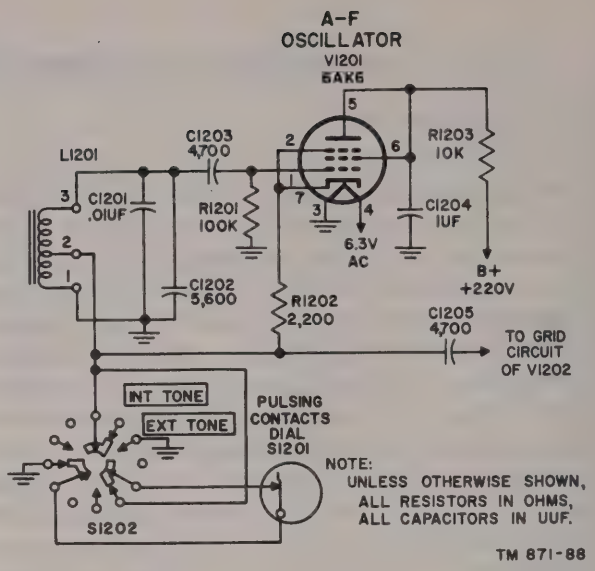


Figure 88. Remote Switching Control C-973/FRR-33, af oscillator, schematic diagram.

101. Af Amplifier
(fig. 89)

a. Impulses of 1,105 cps tone developed by the af oscillator are applied to af amplifier V1202. This stage provides sufficient amplification of the tones to supply a 600-ohm balanced line at the proper signal level. Tube V1202 uses a type 6AK6 in a conventional transformer-coupled amplifier stage.

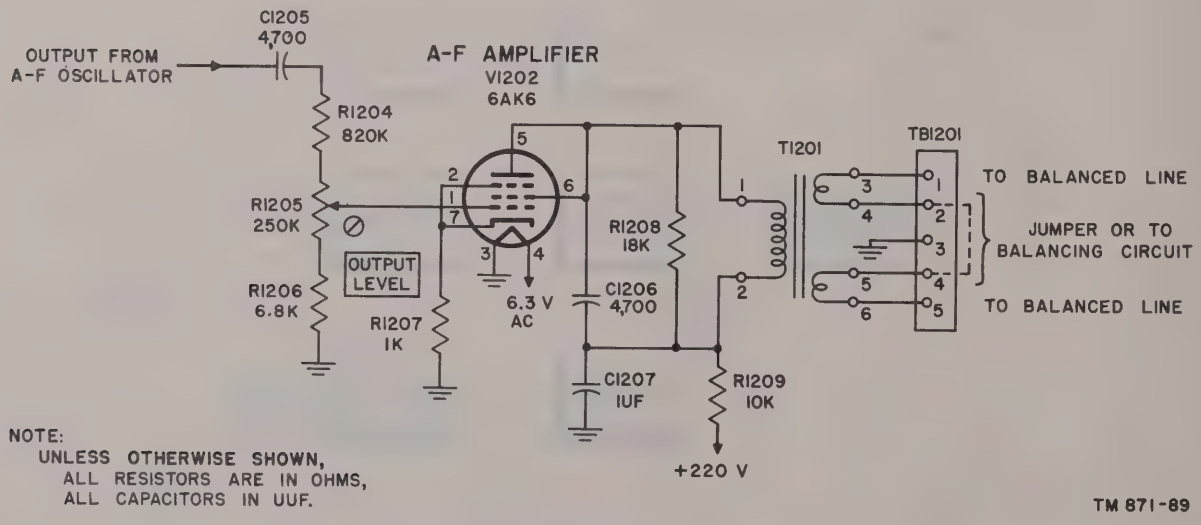


Figure 89. Remote Switching Control C-973/FRR-33, af amplifier, schematic diagram.

b. Operating bias for the amplifier is developed across unbypassed cathode resistor R1207. The plate and screen grid are connected for triode operation. B+ voltage is applied to the plate (and screen grid) through voltage-dropping resistor R1209 and the parallel combination of loading resistor R1208 and transformer T1201 primary. Decoupling of the plate return is provided by capacitor C1207.

c. Tone input is applied through resistor R1204 to OUTPUT LEVEL potentiometer R1205. The level of the tone impulses to be applied to the control grid is set by adjustment of potentiometer R1205, a screwdriver adjustment on the rear of the unit. The maximum and minimum level is limited by resistors R1204 and R1206, respectively. The plate load impedance consists of the primary impedance of transformer T1201, impedance of capacitor C1206, and resistance of R1208 connected in parallel. This plate load impedance is 10,000 ohms when a 600-ohm load impedance is connected across the secondary of transformer T1201. Capacitor C1206 helps to eliminate transients in the output due to keying, or dialing of the oscillator. Center leads of the split secondary winding of T1201 are connected to terminals 2 and 4 of terminal board TB1201. The terminals are either connected together or connected to a line-balancing circuit. Tone impulses at output terminals 1 and 5 of TB1201 are applied to a 600-ohm line. This line is connected to a maximum of three radio receiving set equipment bays.

102. Relay Control Stage
(fig. 90)

a. Since an interval after dialing is required for tuning shafts in the various components to return to normal position, TUNING IN PROGRESS lamp I 1202 is maintained on for 15 to 20 seconds after dialing to indicate to the remote operator that time must be allowed before operating the dial again. The timing circuit for controlling lamp I 1202 includes relay control tube V1203 (type 6AK6) and plate relay K1201. An increase in the plate current of V1203 operates K1201, which closes its contacts to complete the operating circuit for lamp I 1202.

b. The relay control tube is normally biased to cutoff and relay K1201 is inoperative. Grid bias required to prevent operation of the relay is developed across bleeder resistors R1211 and R1212 connected in series from cathode to ground. Resistor R1213, connected between cathode and B+, completes the cathode bleeder circuit. When the dial off-normal springs are in their normal open position, the dc return for the control grid is through resistor R1210 to ground. Operation of dial S1201 closes

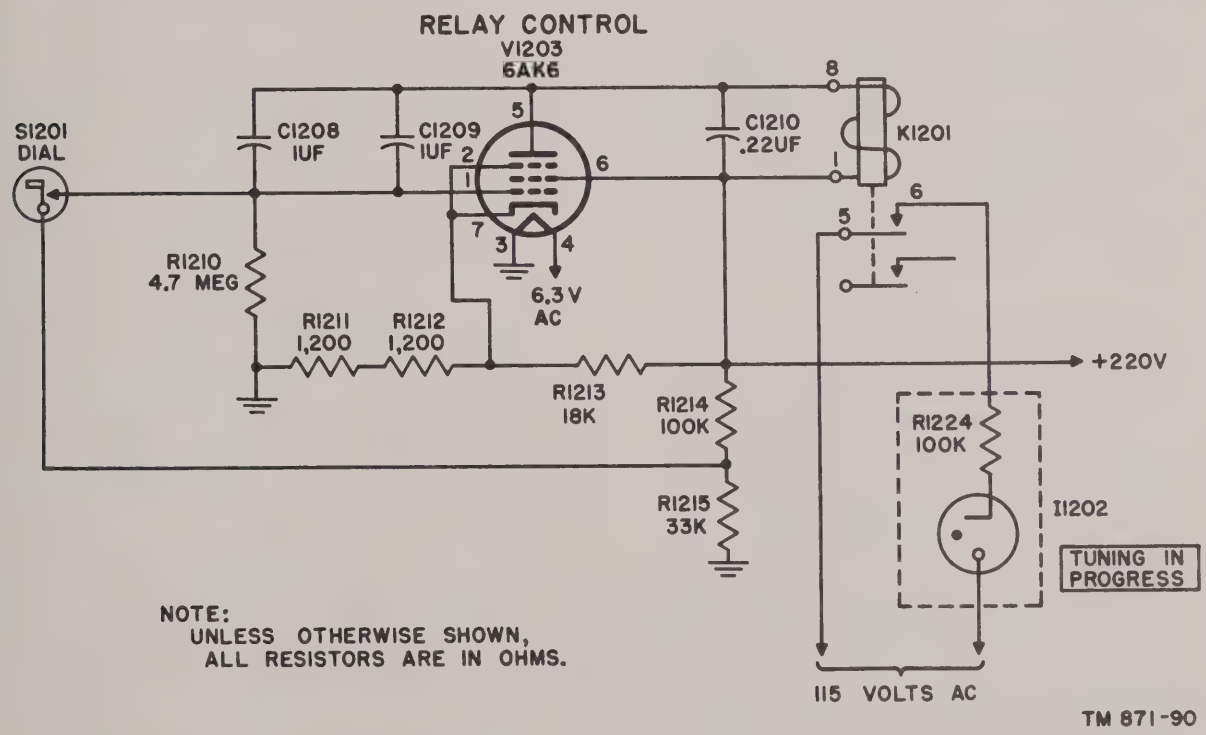


Figure 90. Remote Switching Control C-973/FRR-33, relay control stage, schematic diagram.

the off-normal springs to apply a positive voltage to the control grid. The positive voltage is obtained from the junction of bleeder resistors R1214 and R1215 connected from B+ to ground. The positive voltage applied to the control grid is sufficient to overcome the bias developed across R1211 and R1212 and to produce an increase in plate current. This operates plate relay K1201. During the time that dial S1201 is operated, and the off-normal springs are closed, capacitor C1208 and C1209 discharge rapidly through resistor R1215. However, when the off-normal springs open at the end of the dialing operation, the charging path for C1208 and C1209 is through resistor R1210. Since R1210 is a 4.7-megohm resistor, the charging time is comparatively long. Also, due to Miller effect, the effective capacity of capacitors C1208 and C1209 is multiplied by the stage gain of V1203. The overall result is a time delay of 15 to 20 seconds before plate relay K1201 becomes inoperative again after dialing is completed.

103. Power Supply

The power supply used in Remote Switching Control C–973/FRR–33 is similar to that used in Antenna Coupler CU–286/FRR–33 (par. 79). The regulated plate voltage circuit, containing V1204, V1205, V1206, and V1207, uses tubes and components identical to those used in the antenna coupler. In this case, however, the B+ adjust potentiometer R1221 is set to give a 220-volt output. A 115-volt pilot lamp circuit for POWER indication is connected across one primary winding of transformer T1202. The circuit includes a neon lamp and resistor R1223 contained within lamp socket XI 1201.

CHAPTER 6

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairman.

Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing the radio receiving set, be careful of the voltages involved. Disconnect the power cable completely, except when making voltage checks. Keep one hand in pocket when measuring socket voltages with a probe. Before touching any part after the voltage is shut off, short the part to ground.

104. Trouble-shooting Procedures

The first step in servicing the equipment is to sectionalize the fault. Sectionalization means tracing the fault to the major component or circuit responsible for the abnormal operation of the set. The second step is to localize the trouble. Localization means tracing the fault to the defective part, such as an open capacitor, burned-out resistor, etc. Some faults such as burned-out resistors and shorted transformers can often be located by sight, smell, and hearing. The majority of faults, however, must be localized by *checking voltages and resistances.*

a. System Sectionalization. System sectionalization consists of determining whether the trouble is in the antenna system, antenna coupler, a receiver, the selector control, receiver control, power supply, remote switching unit, power source, or interconnections. If the fault has been sectionalized to any of the above units other than the receiver, receiver control, and power supply, refer to the information given in this chapter to localize the trouble in the defective unit. If the fault is in either the receiver or receiver control unit, refer to the instruction books covering Radio Receiver R–391/URR and Receiver Control C–975/URR to localize the trouble in the defective unit.

(1) Operate the radio receiving set and observe its performance. See equipment performance checklist (par. 69) for normal operating indications.

(2) If the entire set is dead, trouble is probably in the power source or cabinet.

(3) If only one unit is dead, trouble is in that unit or its power cable. If trouble is a blown fuse do not continue to burn out fuses before looking elsewhere to determine the basic cause of trouble.

(4) If no signal is received on one pair of antennas, try the second pair. If signal is still not available the antenna coupler or interconnecting cables between antenna coupler and receivers is probably at fault. Try several channels to check antenna coupler.

(5) If one receiver exhibits unsatisfactory performance such as excessive noise, howling, or weak signals, replace it with a good receiver. If the trouble disappears, the replaced receiver is defective. If the trouble persists the receiver is not at fault.

(6) If the audio signal to the teletypewriter equipment drifts in frequency or disappears, place the OFF-BFO-AFC switch in the BFO position and use the bfo in each receiver. If trouble disappears the receiver control is defective.

(7) By the use of procedures similar to the simple checks given above the trouble can be isolated to a particular unit.

b. Component Sectionalization and Localization. The tests listed below aid in isolating the source of trouble. To be effective, the procedure should be followed in the order given. Remember that servicing procedure should cause no further damage to the equipment. First, trouble should be localized to a single stage or circuit. Then the trouble may be isolated within the stage by appropriate voltage, resistance, and continuity measurements. The

service procedure is summarized as follows:

(1) *Visual inspection.* The purpose of visual inspection (par. 68) is to locate any visible trouble. Through this inspection alone the repairman frequently may discover the trouble, or determine the stage in which the trouble exists. This inspection is valuable in avoiding additional damage to the equipment which might occur through improper servicing methods and in forestalling future failures.

(2) *B+ resistance measurements.* These measurements (par. 107) prevent further damage to the equipment from possible short circuits.

(3) *Operational test.* The operational test (par. 109) is important because it frequently indicates the general location of trouble. In many instances the information gained will determine the exact nature of the fault. To use this information fully, all symptoms must be interpreted in relation to one another.

(4) *Trouble-shooting chart.* The troubles listed in this chart (par. 110) will aid greatly in localizing trouble.

(5) *Signal tracing.* The principal advantage of the signal tracing method (par. 113) is that it usually enables the repairman to localize a trouble accurately and quickly to a given stage when the general location of the trouble is not immediately evident from the above tests.

(6) *Stage gain charts.* These charts (par. 118) can be used to localize obscure, hard-to-find troubles.

(7) *Intermittents.* In all of these tests the possibility of intermittents should not be overlooked. If present, this type of trouble may be made to appear by tapping or jarring a unit. It is possible that the trouble is not in the equipment itself, but in the installation; the trouble may also be due to external conditions. In this event test the installation, if possible.

105. Trouble-shooting Data

Take advantage of the material supplied in this instruction book. It will help in the rapid location of faults. Consult the following trouble-shooting data:

a. Antenna Coupler CU–286/FRR–33.

Fig. No.	Description
123	Antenna Coupler CU–286/FRR–33, schematic diagram.
122	Antenna Coupler CU–286/FRR–33, wiring diagram.
91	Antenna Coupler CU–286/FRR–33, tube socket voltage and resistance diagram.
92	Antenna Coupler CU–286/FRR–33, terminal boards, voltage and resistance measurements.
118	Antenna Coupler CU–286/FRR–33, B+ voltage distribution diagram.
97	Antenna Coupler CU–286/FRR–33, top view of chassis.
8	Antenna Coupler CU–286/FRR–33, rear view of chassis.
98	Antenna Coupler CU–286/FRR–33, bottom view of chassis.

b. Radio Receiver R–391/URR. For trouble-shooting data on the receiver, refer to the instruction book covering the radio receiver.

c. Selector Control C–974/FRR–33.

Fig. No.	Description
126	Selector Control C–974/FRR–33, schematic diagram.
125	Selector Control C–974/FRR–33, wiring diagram.
93	Selector Control C–974/FRR–33, tube socket voltage and resistance measurements.
94	Selector Control C–974/FRR–33, terminal boards, voltage and resistance measurements.
119	Selector Control C–974/FRR–33, B+ voltage distribution diagram.
99	Selector Control C–974/FRR–33, top view of chassis.
12	Selector Control C–974/FRR–33, rear view of chassis.
100	Selector Control C–974/FRR–33, bottom view of chassis.

d. Receiver Control C–975/URR. For trouble-shooting data on the receiver control, refer to the instruction book covering the receiver control.

e. Power Supply PP–629/URR.

Fig. No.	Description
86	Power Supply PP–629/URR, schematic diagram.
128	Power Supply PP–629/URR, wiring diagram.
16	Power Supply PP–629/URR, rear view of chassis.
101	Power Supply PP–629/URR, bottom view of chassis.

f. Remote Switching Control C–973/FRR–33.

Fig. No.	Description
130	Remote Switching Control C–973/FRR–33, schematic diagram.
129	Remote Switching Control C–973/FRR–33, wiring diagram.
95	Remote Switching Control C–973/FRR–33, tube socket voltage and resistance measurements.
96	Remote Switching Control C–973/FRR–33, terminal boards, voltage and resistance measurements.
120	Remote Switching Control C–973/FRR–33, B+ voltage distribution diagram.
102	Remote Switching Control C–973/FRR–33, top view of chassis.
18	Remote Switching Control C–973/FRR–33, rear view of chassis.
103	Remote Switching Control C–973/FRR–33, bottom view of chassis.

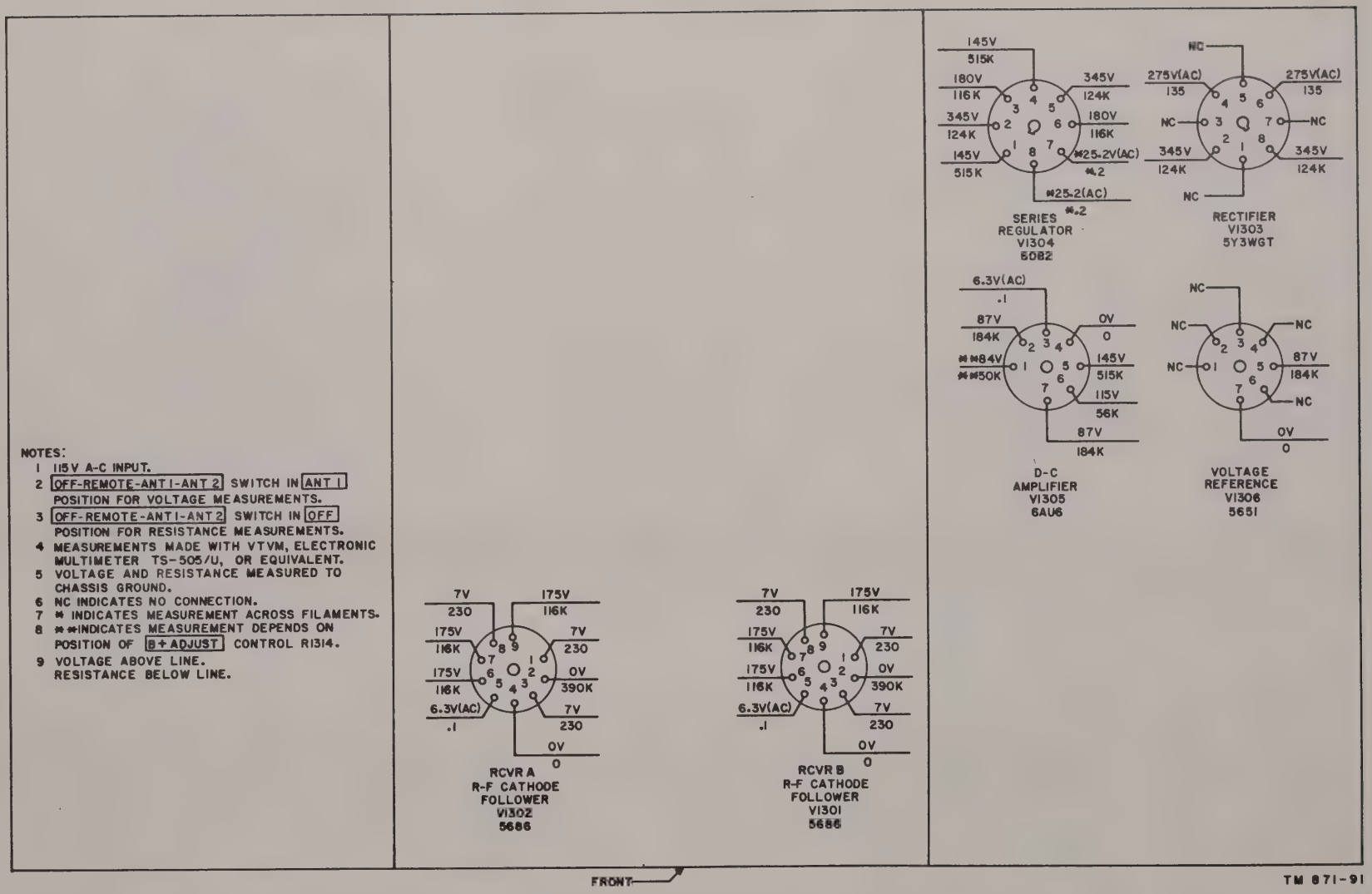

NOTES:
1 115 V A-C INPUT.
2 OFF-REMOTE-ANT 1-ANT 2 SWITCH IN ANT 1 POSITION FOR VOLTAGE MEASUREMENTS.
3 OFF-REMOTE-ANT 1-ANT 2 SWITCH IN OFF POSITION FOR RESISTANCE MEASUREMENTS.
4 MEASUREMENTS MADE WITH VTVM, ELECTRONIC MULTIMETER TS-505/U, OR EQUIVALENT.
5 VOLTAGE AND RESISTANCE MEASURED TO CHASSIS GROUND.
6 NC INDICATES NO CONNECTION.
7 * INDICATES MEASUREMENT ACROSS FILAMENTS.
8 **INDICATES MEASUREMENT DEPENDS ON POSITION OF B+ ADJUST CONTROL R1314.
9 VOLTAGE ABOVE LINE.
RESISTANCE BELOW LINE.
7V 230
175V 116K
175V 116K
6.3V(AC) .1
RCVR A R-F CATHODE FOLLOWER V1302 5686
RCVR B R-F CATHODE FOLLOWER V1301 5686
145V 515K
180V 116K
345V 124K
*25.2V(AC) *.2
SERIES REGULATOR V1304 6082
NC
275V(AC) 135
RECTIFIER V1303 5Y3WGT
87V 184K
**84V **50K
0V 0
115V 56K
D-C AMPLIFIER V1305 6AU6
VOLTAGE REFERENCE V1306 5651
FRONT
TM 871-91

Figure 91. Antenna Coupler CU-286/FRR-33, tube socket voltage and resistance diagram.

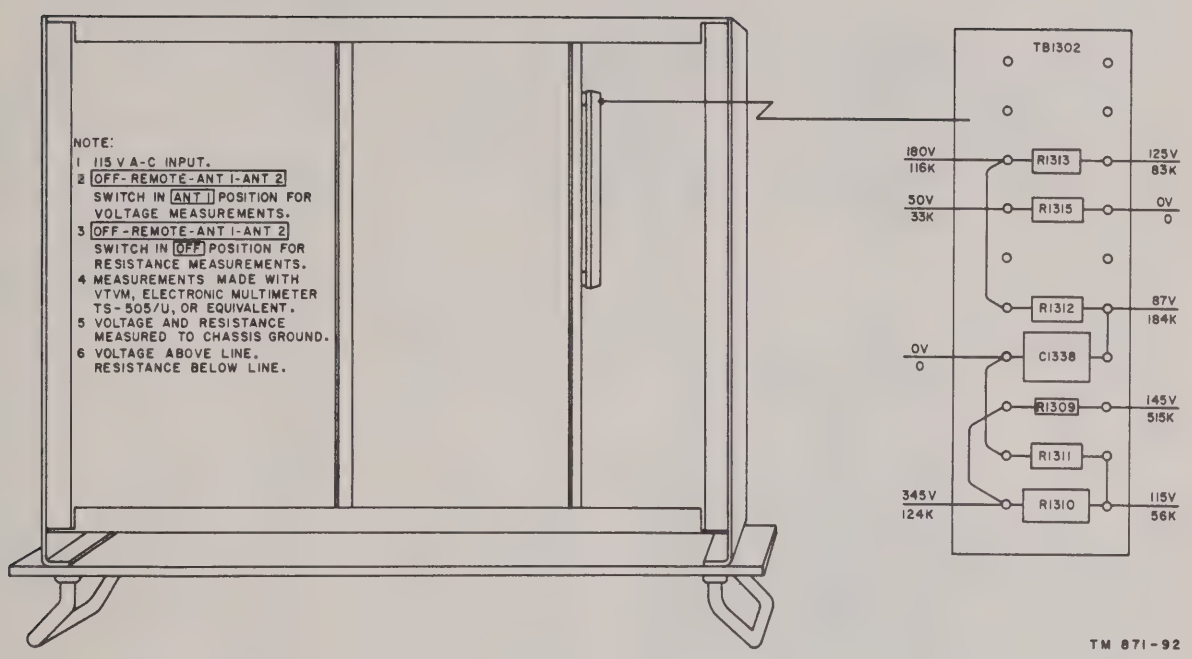


Figure 92. Antenna Coupler CU-286/FRR-33, terminal board voltage and resistance diagram.

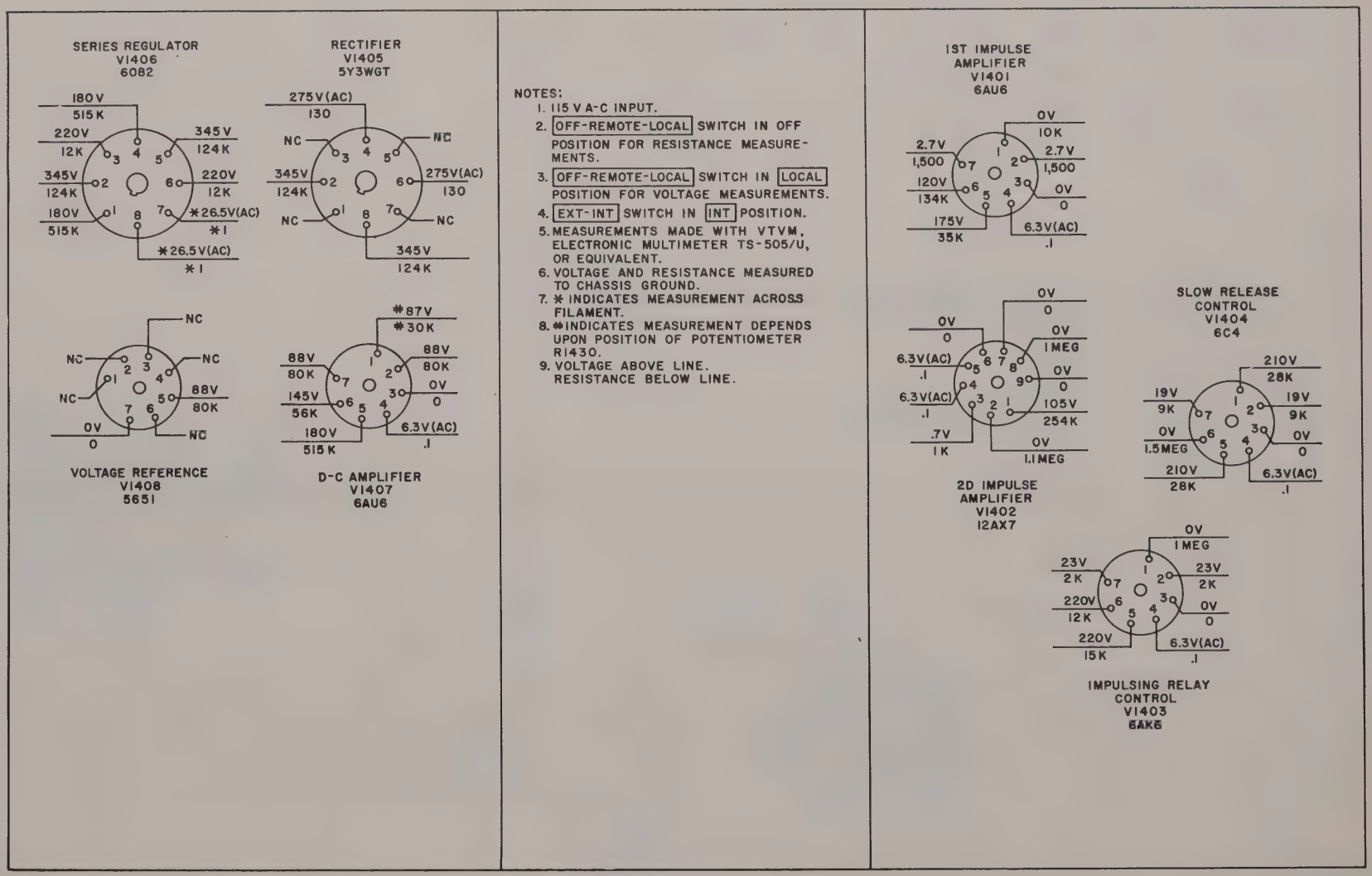


Figure 93. Selector Control C-974/FRR-33, tube socket voltage and resistance diagram.

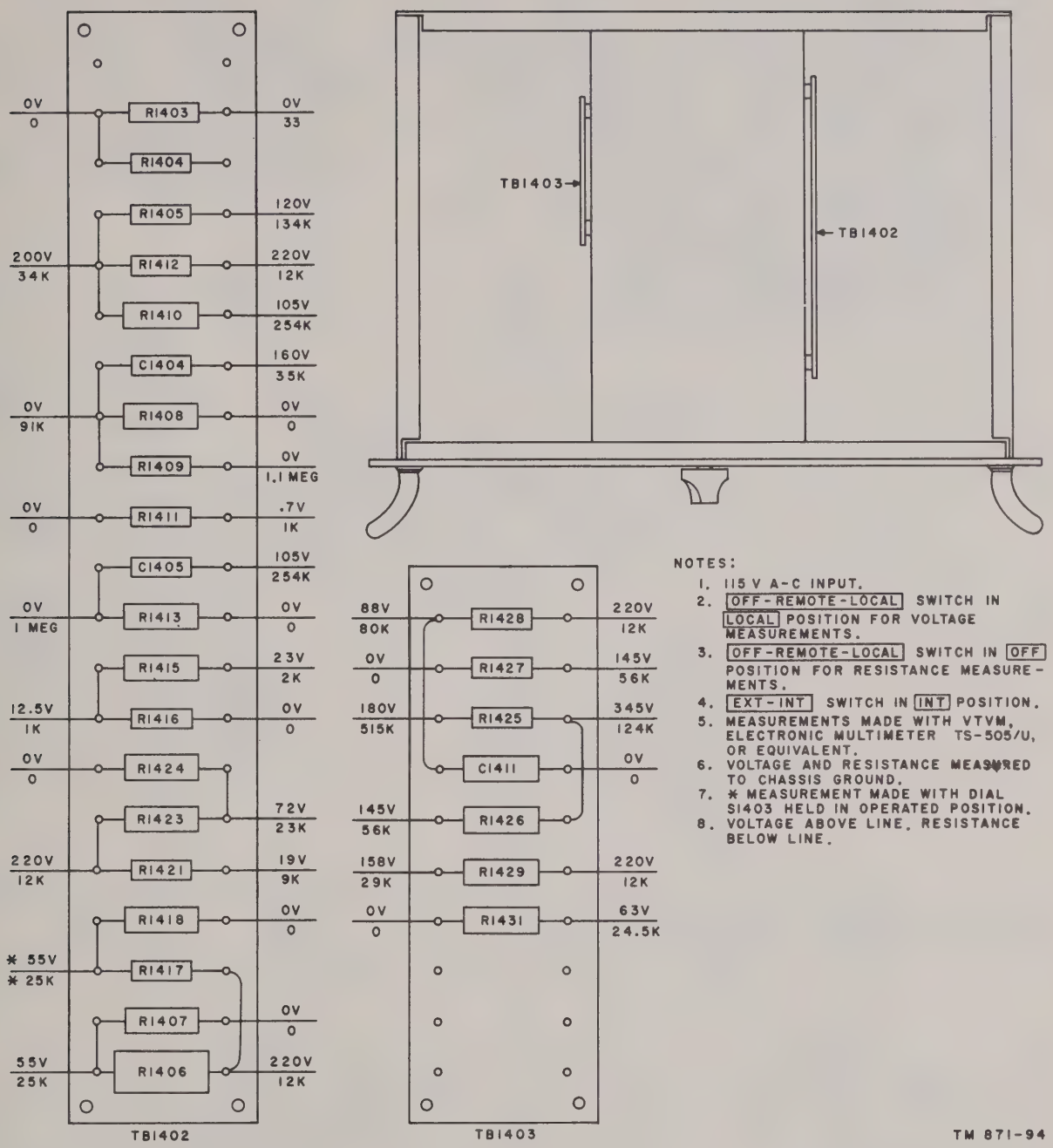


Figure 94. Selector Control C-974/FRR-33, terminal board voltage and resistance diagram.

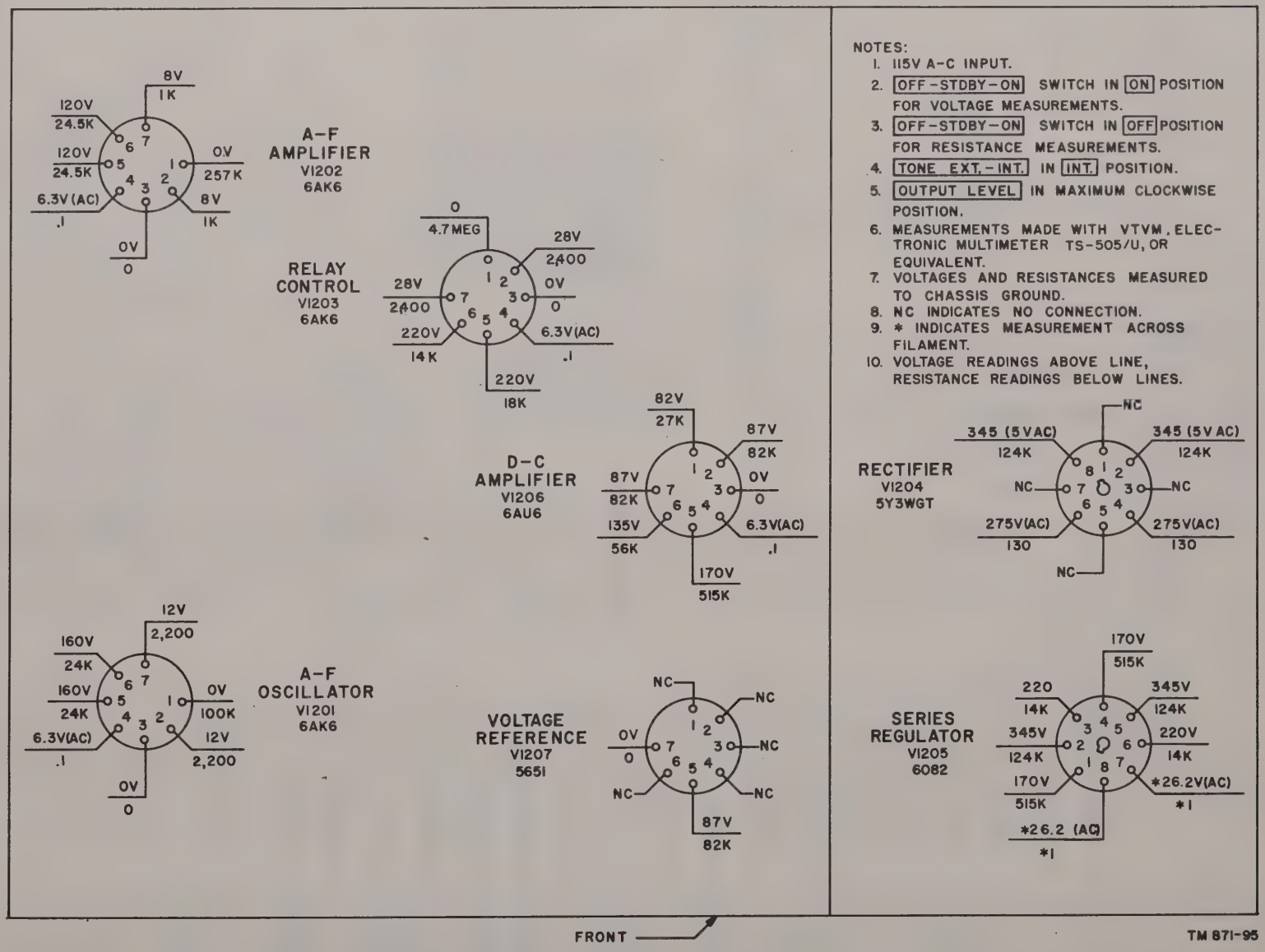


Figure 95. Remote Switching Control C-973/FRR-33, tube socket voltage and resistance diagram.

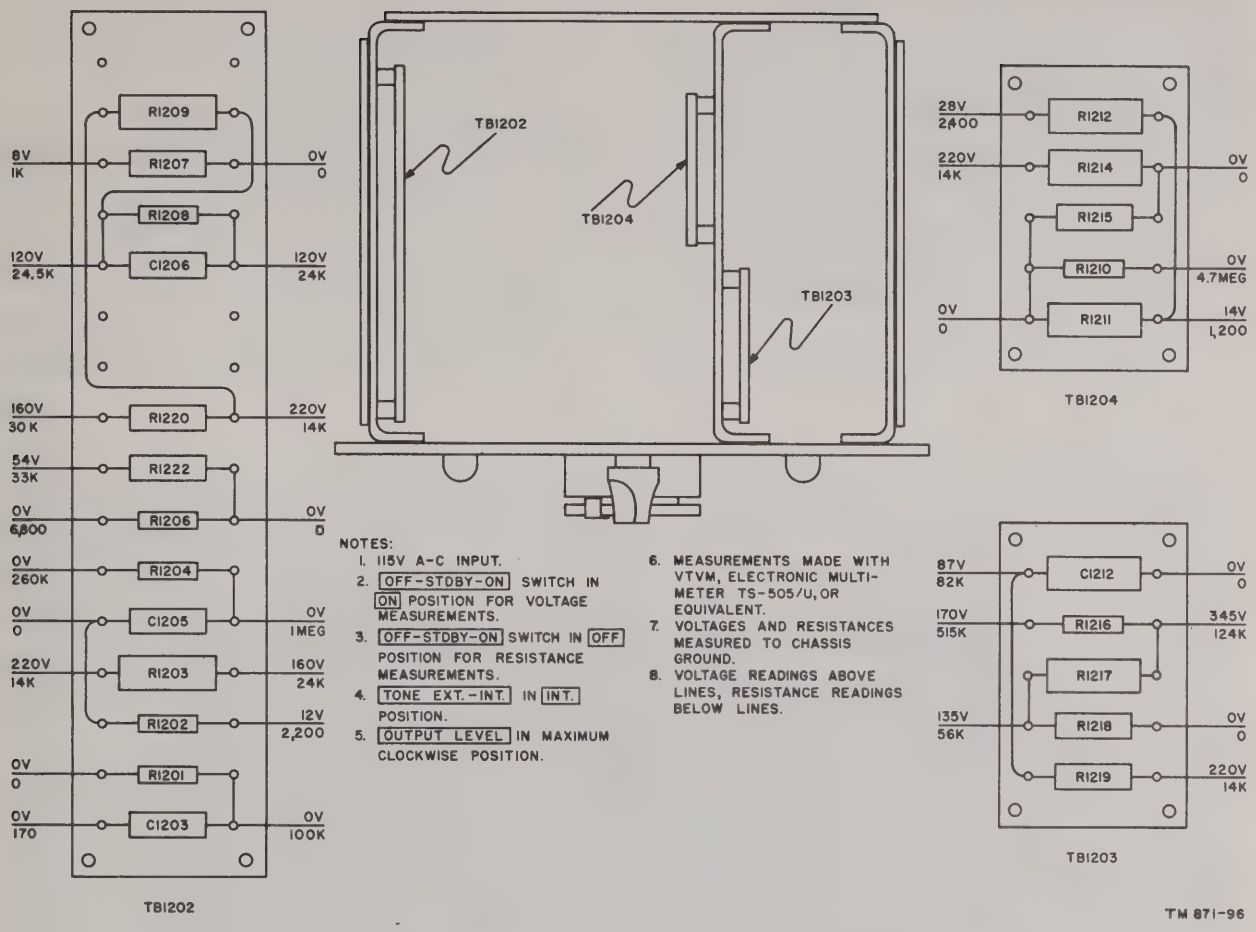


Figure 96. Remote Switching Control C-973/FRR-33, terminal board voltage and resistance diagram.

106. Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting Radio Receiving Set AN/FRR–33 is listed below. The technical manuals associated with the test equipment are also listed.

Test equipment	Technical manual
RF Signal Generator Set AN/URM–25, or equal	TM 11–5551
Audio Oscillator TS–382A/U, or equal	TM 11–2684A
Electron Tube Test Set TV–2/U, or equal	TM 11–2661
Multimeter TS–297/U, or equal	TM 11–5500
Electronic Multimeter ME–6A/U, or equal	TM 11–5549
Oscilloscope OS–8A/U, or equal	TM 11–1214
Electronic Multimeter TS–505/U, or equal	TM 11–5511
High-impedance headset.	

107. Checking B+ Circuits for Shorts

Trouble within one of the components of the radio receiving set may often be detected by checking the resistance of the high-voltage circuits before applying power to the equipment. This may prevent damage to a power supply. For detailed information concerning Radio Receiver R–391/URR and Receiver Control C–975/URR, refer to the instruction books covering the units.

Note. Before making the following measurements disconnect the power cable of the particular unit being checked.

a. Antenna Coupler CU–286/FRR–33.

(1) The dc resistance measured between B+ CHECK test jack J1344 (fig. 97) and ground should be approximately 116,000 ohms. If the resistance is low, check the plate circuits of tubes V1301 and V1302. If the resistance is zero, bypass capacitors C1318 and C1336 (fig. 98) is probably shorted.

(2) The dc resistance measured between pin 2 (or 5) of tube V1304 (fig. 30) and ground should be approximately 124,000 ohms. If the resistance is zero or low check capacitor C1337 (fig. 97).

b. Selector Control C–974/FRR–33.

(1) The dc resistance measured between test jack J1472 (fig. 99) and ground should be approxi-

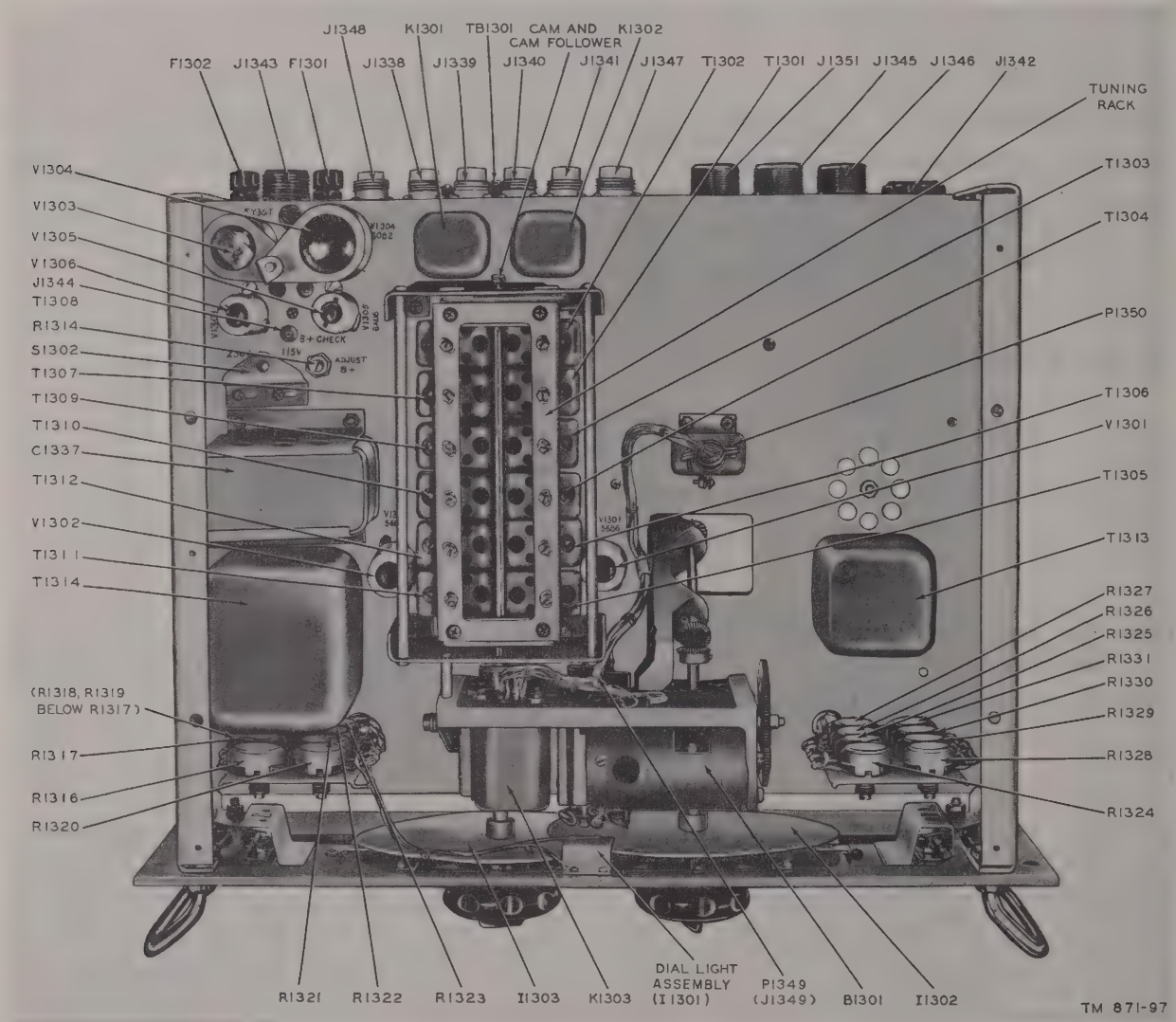


Figure 97. Antenna Coupler CU-286/FRR-33, top view.

mately 12,000 ohms. If the resistance is low, check the various voltage dividers, plate, and screen grid circuits in the selector control.

(2) The dc resistance measured between pin 2 (or 5) of tube V1406 (fig. 33) and ground should be approximately 124,000 ohms. If the resistance is zero or low check capacitor C1409 (fig. 99).

c. Remote Switching Control C–973/FRR–33.

(1) The dc resistance measured between pin 3 (or 6) of tube V1205 (fig. 35) and ground should be approximately 14,000 ohms. A low resistance indicates a probable defect in a voltage divider, plate, or screen grid circuit of one of the stages in the unit.

(2) The dc resistance measured between pin 2 (or 5) of tube V1205 and ground should be approximately 124,000 ohms. If the resistance is zero or low capacitor C1211 (fig. 102) is probably defective.

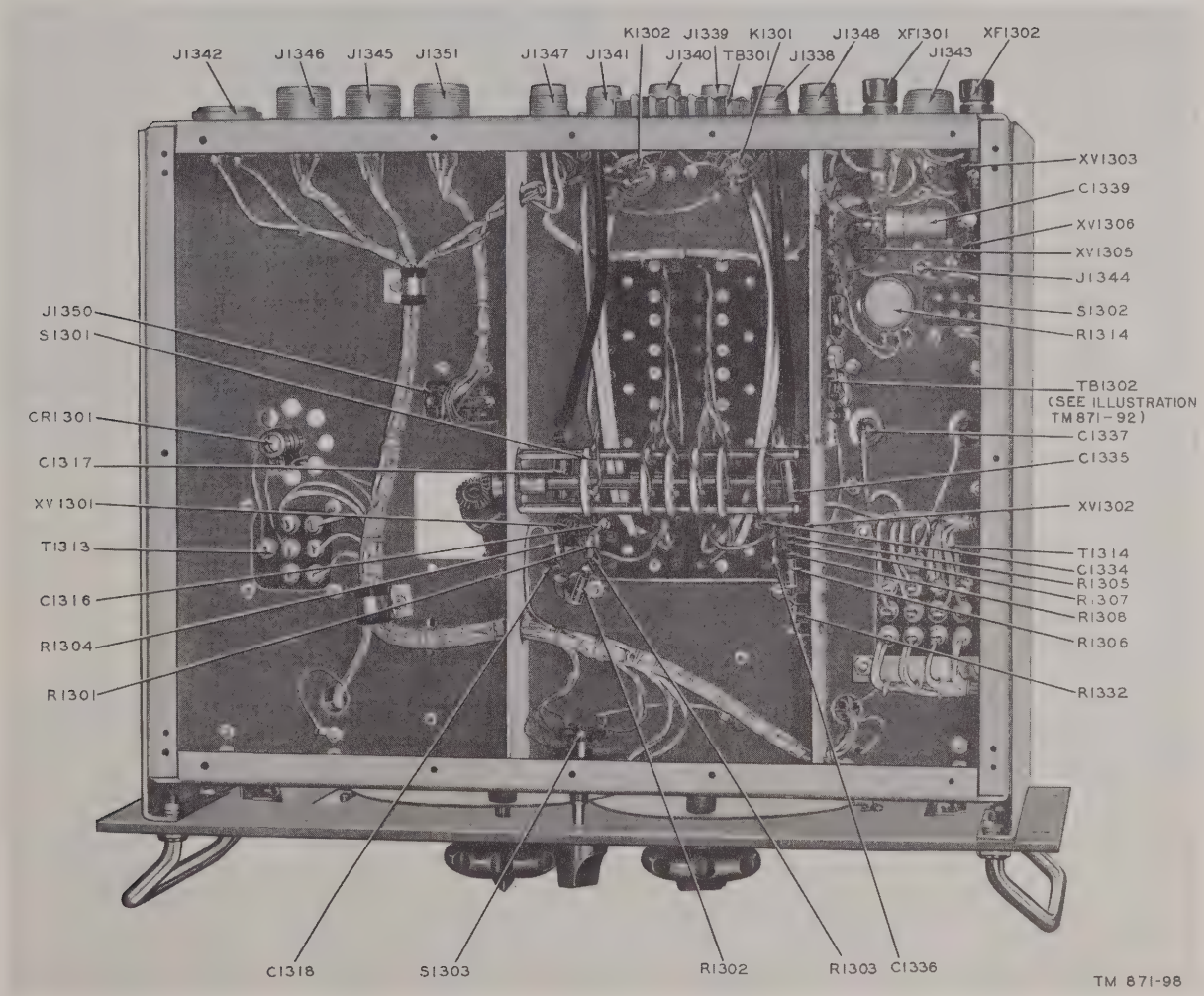


Figure 98. Antenna Coupler CU-286/FRR-33, bottom view.

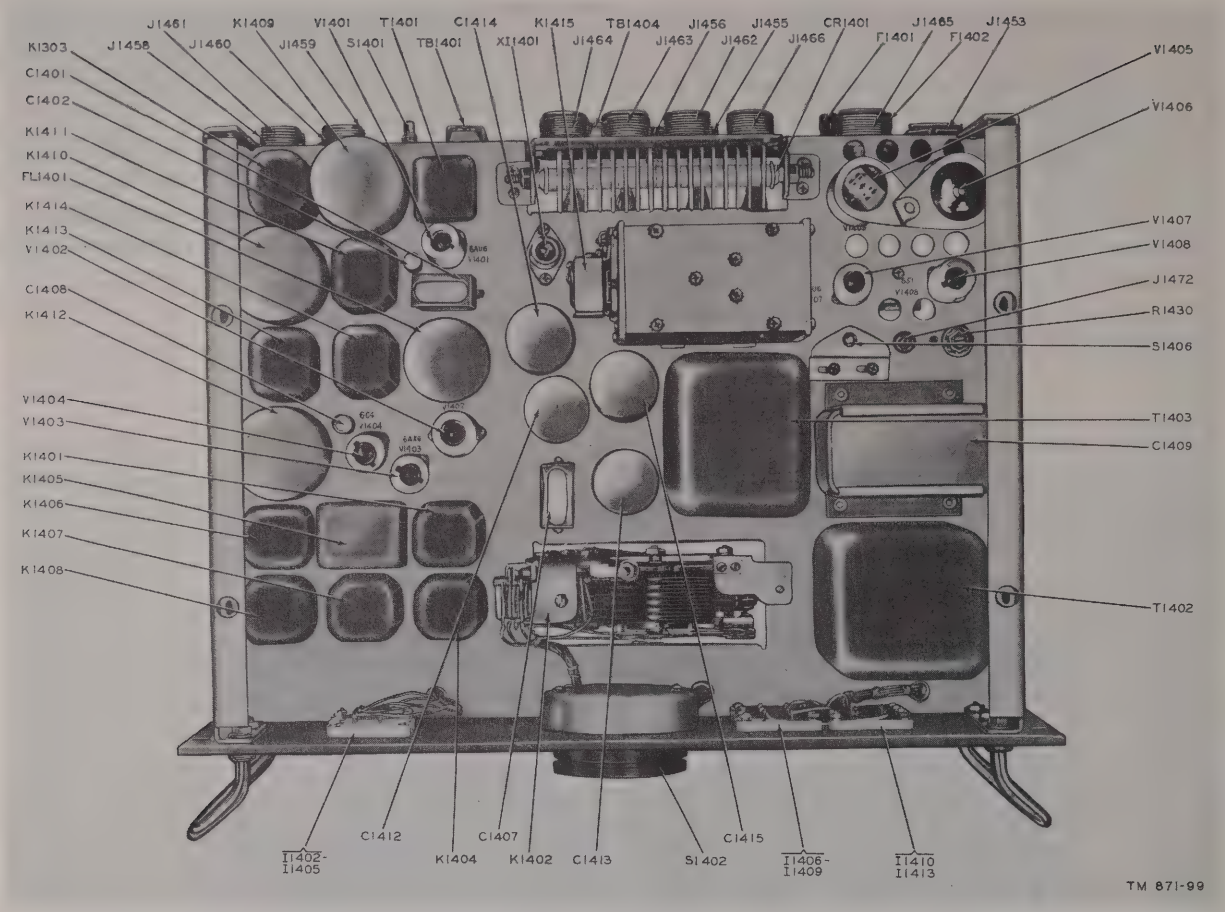


Figure 99. Selector Control C-974/FRR-33, top view.

108. Dc Resistance of Transformers and Coils

The dc resistances of the various transformers and inductors are listed in the following table:

Unit	Component	Terminals	Ohms
Antenna Coupler CU–286/FRR–33	T1313	1–2	500
		3–4	500
		5–6	Less than 1
		6–7	Less than 1
	T1314	1–2	4.5
		3–4	4.5
		5–6	130
		6–7	130
		8–9	1
		10–11	Less than 1
		12–13	Less than 1

Unit	Component	Terminals	Ohms
Selector Control C–974/FRR–33	T1401	1–2	560
		3–4	30
		5–6	30
	L1401		600
	T1402	1–2	4.5
		3–4	4.5
		5–6	130
		6–7	130
		8–9	1
		10–11	Less than 1
		12–13	Less than 1
	T1403	1–2	6
		3–4	6
		5–6	Less than 1
		6–7	Less than 1
		7–8	Less than 1
Power Supply PP–629/URR	T1101	1–2	Less than 1
		3–4	Less than 1
		5–6	Less than 1
		5–7	Less than 1
		5–8	Less than 1
		5–9	Less than 1
Remote Switching Control C–973/FRR–33	L1201	1–2	44
		2–3	126
	T1201	1–2	560
		3–4	30
		5–6	30
	T1202	1–2	4.5
		3–4	4.5
		5–6	130
		6–7	130
		8–9	1
		10–11	Less than 1
		12–13	Less than 1

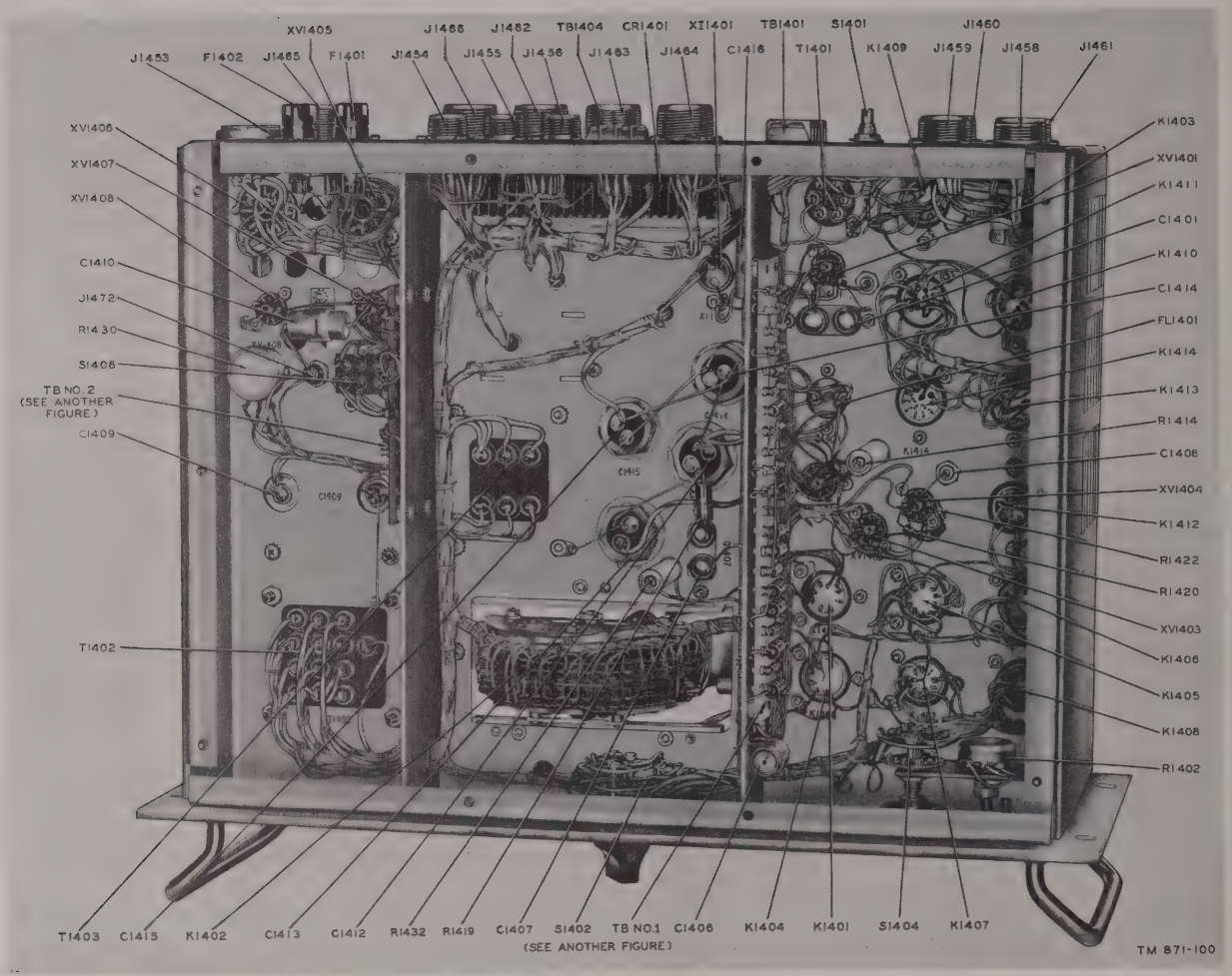


Figure 100. Selector Control C-974/FRR-33, bottom view.

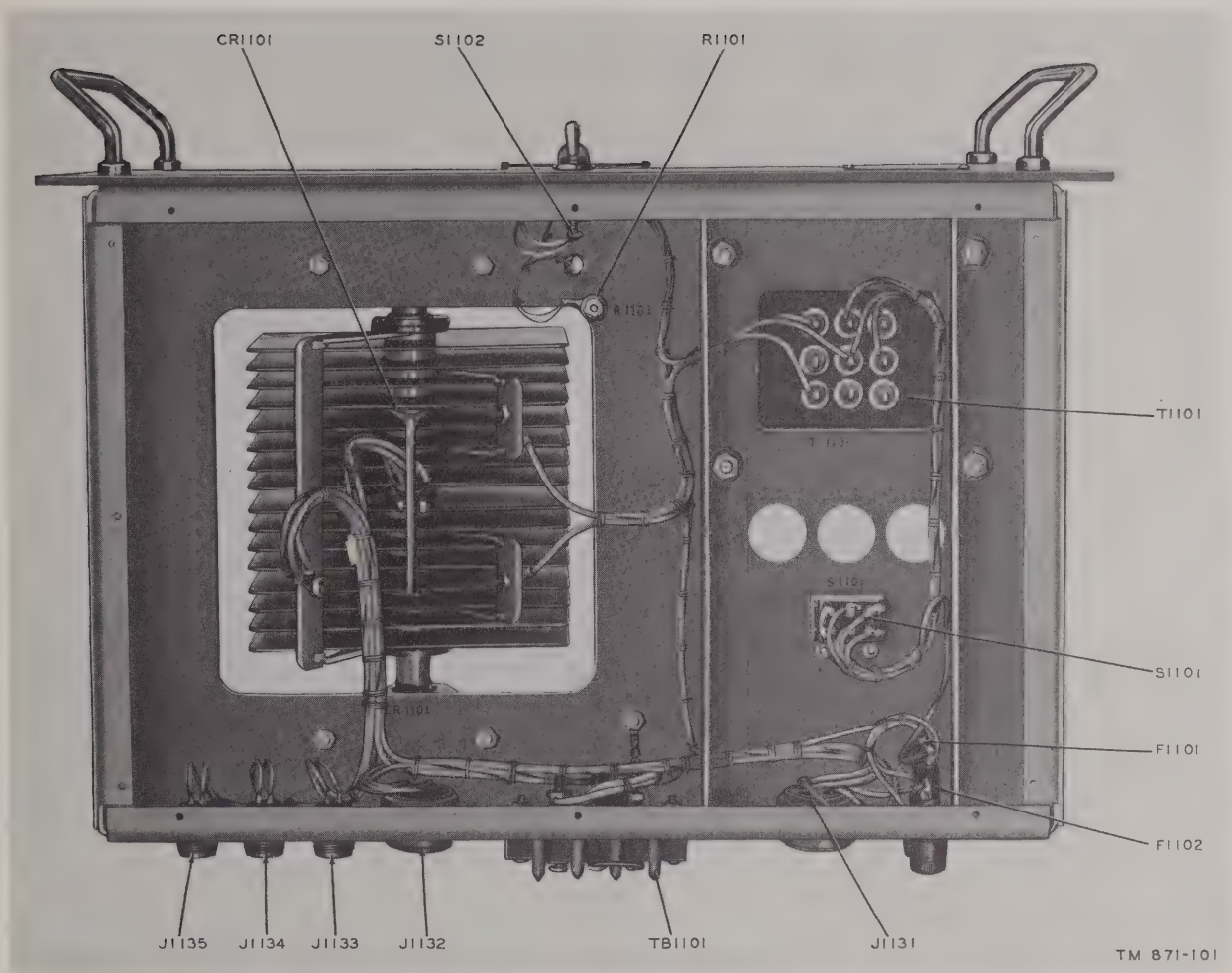


Figure 101. Power Supply PP-629/URR, bottom view.

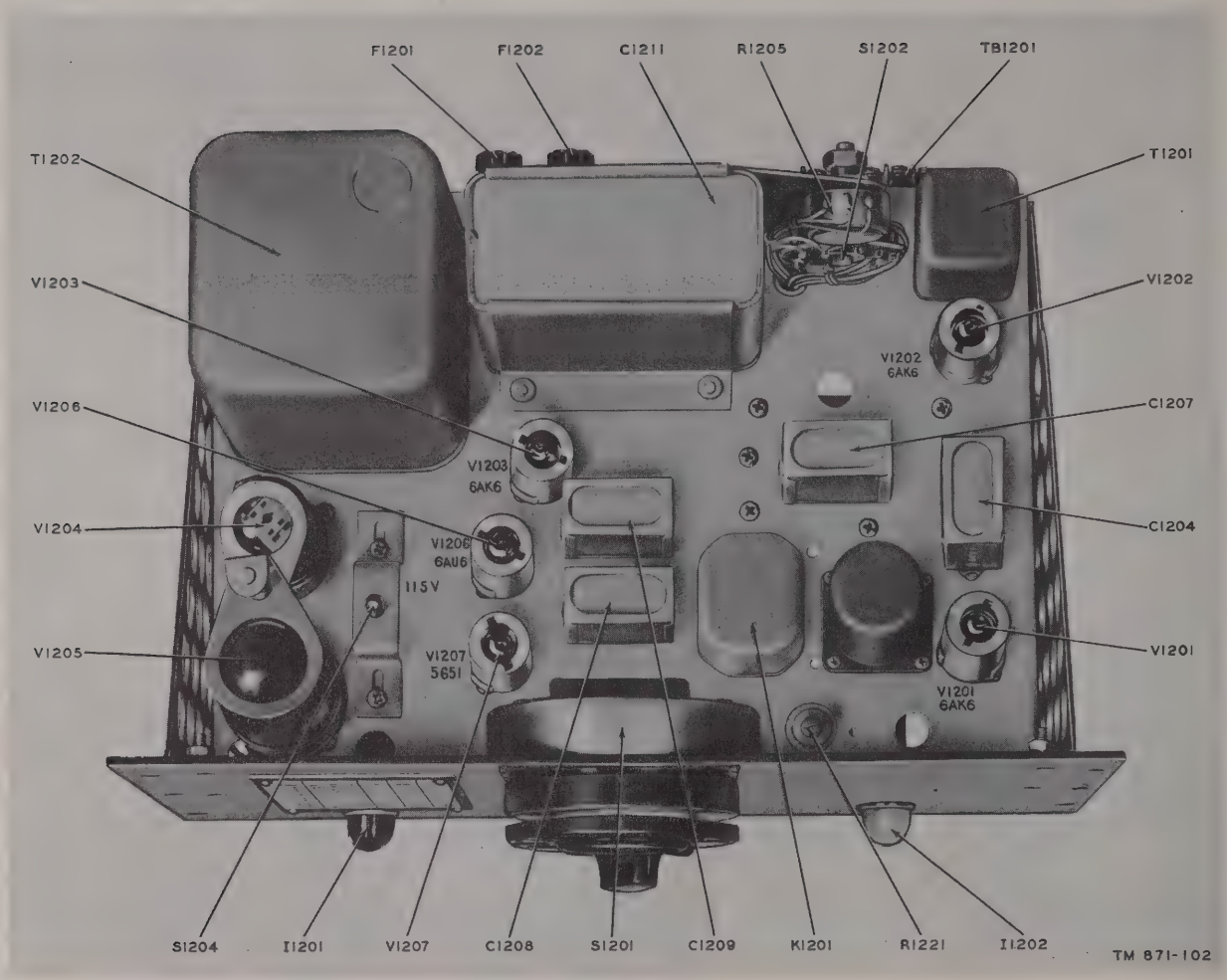


Figure 102. Remote Switching Control C-973/FRR-33, top view.

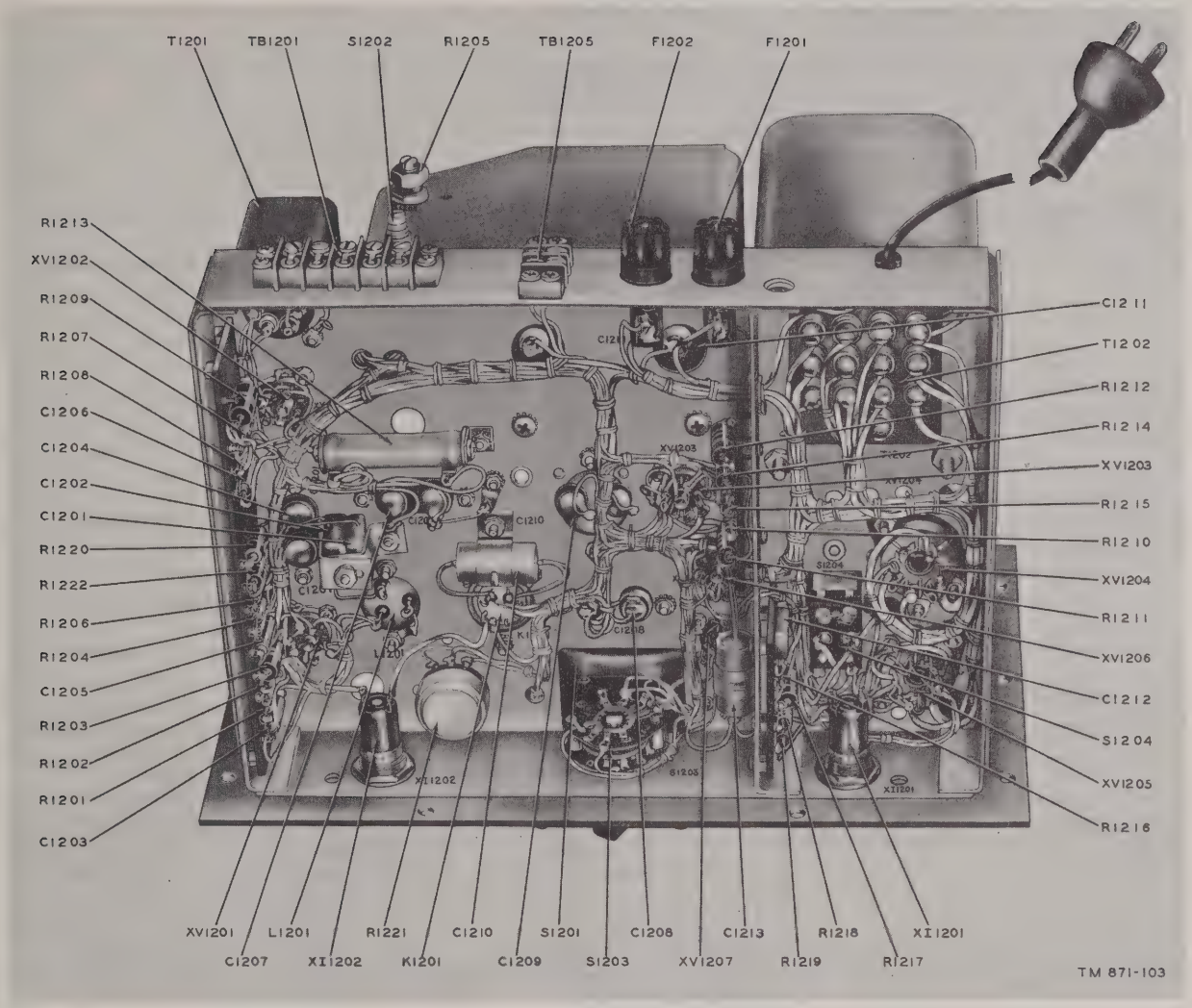


Figure 103. Remote Switching Control C-973/FRR-33, bottom view.

109. Operational Test

The operational test is used to check all of the functions of the radio receiving set. In this test, all of the various conditions of the equipment should be checked. Tests should be made from both remote and local positions. Refer to the equipment performance checklist (par. 69) to check for the troubles that might be encountered.

110. Trouble-shooting Chart

The following charts are supplied as an aid in locating trouble in Radio Receiving Set AN/FRR–33 and its individual components. These charts list the symptoms which the repairman observes, either visually or audibly, while making a few simple tests. They also indicate how to localize trouble in the antenna coupler, selector control, power supply, and remote switching control. For detailed information concerning Radio Receiver R–391/URR and Receiver Control C–975/URR, refer to the instruction books covering these units. The signal substitution tests outlined in paragraphs 112, 113, 114 and 115 can then be used to supplement this procedure and to determine the defective stage. Once the trouble has been localized to a stage or circuit, a tube check and voltage

and resistance measurements of this stage or circuit ordinarily should be sufficient to isolate the defective part. Normal voltage and resistance measurements are given in figures 91 through 96 and in the instruction books of the receiver and receiver control.

a. Sectionalizing Trouble in Radio Receiving Set AN/FRR–33.

Symptom	Probable trouble	Correction
1. Equipment dead; tubes and pilot lamps do not light.	1. Main fuse blown. Power connections faulty.	1. Replace main fuse. Check and repair power connections (par. 21*d*).
2. Severe fading of signals.	2. Radio receiver improperly connected. Defective receiver. Antenna improperly connected. One channel in antenna coupler not functioning properly. One channel in receiver control not functioning properly.	2. Check all connections (par. 21). Repair receiver. Check antenna connections (par. 21*c*). Repair antenna coupler. Repair receiver control.
3. Signals normal in receiver phones, but no signal input to radio teletype terminal equipment.	3. Line af amplifier circuit in receiver faulty.	3. Repair radio receiver.
4. Signals normal at terminal equipment, but no signal output in receiver phones.	4. Local audio amplifier circuit in receiver faulty.	4. Repair radio receiver.
5. Erratic keying in automatic printing equipment.	5. AFC THRESHOLD not set properly. Receiver control defective. Defective terminal equipment.	5. Readjust AFC THRESHOLD control (par. 34). Repair receiver control. Repair terminal equipment. See TM 11–356.

b. Localizing Trouble in Antenna Coupler CU–286/FRR–33.

Symptom	Probable trouble	Correction
1. No signal output to one or both receivers.	1. Connecting cables defective. Defective antenna. No B+ voltage. Dirty switch contacts on S1303.	1. Check cables and replace if necessary (par. 21). Check antenna system. Correct any fault (par. 21*c*). Refer to step 2. Clean or replace switch (fig. 98).
2. No B+ voltage.	2. Defective hv rectifier tube V1303. Fuse F1302 blown. Defective series regulator tube V1304. Open high-voltage winding on transformer T1314.	2. Replace tube V1303 (fig. 30). Replace fuse (fig. 39); if it blows again, refer to step 4. Replace V1304 (fig. 30). Check winding resistance (par. 108). If an open winding is found, replace T1314 (fig. 97).
3. Fuse F1301 blows.	3. Improper setting of switch S1302 for line voltage used. Short in power supply.	3. Check setting of S1302 (fig. 97). If incorrect, set to proper position. Make resistance checks (fig. 91). Trouble probably in filament circuits; otherwise F1302 should blow.
4. Fuse F1302 blows.	4. Shorted capacitor C1337. Shorted capacitor C1336 or C1318.	4. Make resistance checks (par. 107*a*).

c. Localizing Trouble in Selector Control C–974/FRR–33.

Symptom	Probable trouble	Correction
1. Selector control inoperative from remote position.	1. No input impulses.	1. Check telephone line and input transformer T1401 (fig. 99). Make suitable corrections.
	Defective tube in impulse circuit.	Check V1401, V1402, V1403, and V1404 (fig. 33). Replace defective tube.
	No B+ voltage.	Refer to step 3.
	C1406 shorted.	Check C1406 (fig. 100) for short. Replace if defective.
	No relay supply voltage.	Make resistance checks (par. 108). Correct defect.
2. Selector control inoperative from local position.	2. Dial contacts shorted on S1403.	2. Locate and remove cause of short on S1403 (fig. 99).
	Defective impulsing relay control tube V1403.	Replace V1403 (fig. 33).
	Open winding on K1401.	Replace relay K1401 (fig. 99).
3. No B+ at test jack J1472.	3. Defective rectifier V1405.	3. Replace V1405 (fig. 33).
	Fuse F1402 blown.	Replace fuse F1402 (fig. 43); if it blows again, refer to step 5.
	Defective regulator tube V1406.	Replace V1406 (fig. 33).
	Open high-voltage winding on transmitter T1402.	Check resistance (par. 108). If an open winding is found, replace T1402 (fig. 99).
4. Fuse F1401 blows.	4. Improper setting of switch S1406 for line voltage used.	4. Check setting of switch S1406 (fig. 99). If incorrect, set to proper position.
	Short in power supply.	Make resistance checks (fig. 93). Trouble probably in filament circuits; otherwise F1402 should blow.
5. Fuse F1402 blows.	5. Shorted capacitor C1409 or B+ circuit.	5. Make resistance checks (par. 107*b*).

Note. No effort has been made to list the possible troubles that may occur in the relay and control circuits of the selector control. A thorough understanding of the circuit description given in paragraphs 85 through 94 should be sufficient to enable the repairman to analyze circuit defects. A table of possible troubles in the Autopositioner system is given in paragraph 111.

d. Localizing Trouble in Power Supply PP–629/URR.

Symptom	Probable trouble	Correction
1. No output voltage.	1. Fuse F1101 or F1102 blown.	1. Replace fuse (fig. 47); if it blows again, refer to step 2.
	Secondary winding of transformer T1101 open.	Measure resistance of winding (par. 108). If open, replace T1101 (fig. 101).
	Defective rectifier CR1101.	Replace rectifier CR1101 (fig. 101).
2. Fuse F1101 or F1102 blows.	2. Improper setting of switch S1101 for line voltage used.	2. Check setting of S1101 (fig. 101). If incorrect, set to proper position.
	Short in secondary circuit of transformer T1101.	Make resistance checks (par. 98). Correct defect. Be sure short is not in external circuit of power supply.

e. Localizing Trouble in Remote Switching Control C–973/FRR–33.

Symptom	Probable trouble	Correction
1. No output impulses.	1. Defective oscillator or amplifier. No. B+ voltage. Dial contacts shorted on S1201.	1. Replace defective tube V1201 or V1202 (fig. 35). Refer to step 2. Locate and remove cause of short on S1201 (fig. 102).
2. No B+ voltage.	2. Defective rectifier V1204. Fuse F1202 blown. Defective series regulator tube V1205. Open high-voltage winding on transformer T1202.	2. Replace V1204. Replace fuse; if it blows again, refer to step 4. Replace V1205 (fig. 35). Check winding resistance (par. 108). If an open winding is found, replace T1202 (fig. 102).
3. Fuse F1201 blows.	3. Improper setting of switch S1204 for line voltage used. Short in power supply.	3. Check setting of S1204 (fig. 102). If incorrect, set to proper position. Make resistance checks (fig. 95). Trouble probably in filament circuits; otherwise F1202 should blow.
4. Fuse F1202 blows.	4. Shorted capacitor C1211 or B+ circuit.	4. Make resistance checks (par. 107).

111. Autotune and Autopositioner Troubleshooting Data

Failure of the radio receiving set to operate properly may be caused by trouble in the Autotune units or the Autopositioner system. Some of the more probable sources of trouble are listed in the following tables. See section II of this chapter for repair instructions.

a. Autotune Units.

Symptom	Probable trouble	Correction
1. One or more Autotune units will not reposition.	1. Units not synchronized.	1. Check defective unit by rotating locked unit control knob throughout the range of rotation, attempting to engage pawl. If pawl can be engaged by this means, resynchronization is probably necessary (par. 118*d*).
2. Resynchronization does not remedy nonpositioning of Autotune units.	2. Stop rings were not locked during cycling. Foreign matter in unit. Broken, unhooked, or weak pawl spring. "Sticky" pawl.	2. Reposition Autotune positioning heads (par. 118*d*). Clean and re-oil unit (par. 118). Reattach or replace (par. 118). Can be made to operate in emergency by working a few drops of MIL–L–644A oil into pawl stack.
3. "Scratchy" operation during manual tuning.	3. Spacing washers rough, possibly dirty.	3. Apply a few drops of MIL–L–7870 oil between stop rings, and between rear stop ring and clutch drum. If this does not remedy trouble, replace stop-ring drum assembly (par. 118).
4. One or several channels cannot be consistently repositioned.	4. Stop rings or ring out of reach of pawl toes.	4. Unlock rings and carefully rotate ring corresponding to inoperative channel so that pawl toe may reach slot in ring. Use small screwdriver or similar tool, applying circumferential force at slot. Be careful not to damage ring.

b. Autopositioner System.

Symptom	Probable trouble	Correction
1. Motor continues to run after Autopositioner sets up.	1. Contacts bent on K1415. Spring weak, pawl does not seat fully.	1. Straighten contacts. Replace solenoid, replace spring, or remove and bend spring to increase tension.
	Seeking switch out of synchronization, causing pawl to drop late and catch on far side of notch and not seat fully.	Adjust switch (par. 119).
	Intermittent or continuous short on negative side of motor.	Remove cause of short.
2. Autopositioner sets up on wrong channel occasionally.	2. Broken wire or poor connection on one or more control wires.	2. Note which channels are defective. Check control wires for those channels and correct defect.
3. Autopositioner sets up on one channel, but continues to run on others.	3. Control wire shorted to ground.	3. Note which channel sets up correctly and check control wire for that channel. Correct fault.
	Switch out of synchronization, allowing pawl to drop too early or too late.	Check visually when set up. Realine as necessary (par. 119).
4. Autopositioner does not set up on any channel, stop wheel turns freely, solenoid opens momentarily each revolution of shaft.	4. Spring bent, pawl does not engage stop wheel with sufficient force to hold.	4. Replace solenoid, replace spring, or remove and bend spring to increase tension.
	Switch out of synchronization.	Realine switch (par. 119).
	Pawl sticks on its pivot.	Remove solenoid. Remove pawl and clean pivot pin. Reassemble pawl and lubricate pivot with MIL–L–644A oil. Replace and realine solenoid.
	Solenoid shifted. Does not allow pawl to seat properly.	Realine solenoid (par. 119).
	Pawl tip shape severely altered; does not hold.	Remove solenoid. Replace pawl with new pawl. Reassemble and readjust solenoid.
5. Autopositioner does not set up on any channel, stop wheel turns freely, solenoid remains energized continuously.	5. Wire from solenoid to seeking switch grounded.	5. Find and remove cause of ground.
	Several or all control wires shorted to ground.	Find and remove cause of short.
6. Autopositioner does not set up, stop wheel does not turn freely, solenoid energized, motor runs.	6. Pawl does not lift clear of notch. Relay shifted away from pawl.	6. Realine solenoid (par. 119).
	Pawl does not lift clear of notch. Solenoid has insufficient travel.	Readjust.
	Driven elements jammed by physical obstruction.	Find and remove obstruction.
	Gear jammed.	Find and remove cause of jam.
	Pawl sticks on its pivot.	Remove solenoid and pawl. Clean pawl and pivot pin. Replace pawl and lubricate pivot with MIL–L–644A oil. Replace and realine solenoid.
	Improper lubrication on bearings at low temperature.	Disassemble and clean bearings as required. Lubricate in accordance with instructions in paragraph 60.
	Insufficient clutch torque, due to broken clutch springs.	Disassemble. Replace spring. Reassemble and realine (par. 119).
	Insuffcient clutch torque, due to glazing of clutch surfaces.	Disassemble. Replace clutch drum and clutch shoe assembly. Reassemble and realine.

111b. (cont)

Symptom	Probable trouble	Correction
7. Autopositioner sets up, then recycles by itself.	7. Spring bent, does not hold pawl in notch properly.	7. Remove spring. Carefully bend spring to increase tension. Reassemble and readjust solenoid air gap.
	Solenoid shifted. Pawl does not seat fully.	Realine solenoid. Check and readjust air gap if necessary.
	Pawl tip altered, excessive slope or radius causes pawl to be pushed out of slot.	Remove solenoid. Replace pawl with new pawl. Reassemble and adjust solenoid.
	Intermittent short circuit between control wires or from wires or switch to ground.	Find and remove cause of short.
	Switch out of synchronization, operation marginal.	Realine switch.
8. Autopositioner solenoid closes, motor does not operate.	8. Relay contacts bent, not closing motor circuit.	8. Adjust contacts.
	Open circuit from relay to motor.	Find and correct cause of open circuit.
	Contacts dirty.	Clean or replace contacts. Check contact adjustment and readjust to obtain proper contact spacing and pressure.
	No power on positive side of motor.	Find and correct cause of open circuit.
	Motor armature burned out.	Replace motor (par. 119).
	Reduction gears jammed.	Find and remove obstruction.
9. Autopositioner solenoid does not operate.	9. No power on positive side of solenoid.	9. Find and correct cause of open circuit.
	Open circuit from solenoid to seeking switch.	Find and correct cause of open circuit.
	Control wire circuit open.	Find and correct cause of open circuit.
	Solenoid coil burned out.	Replace solenoid coil (par. 119).
	No air gap on solenoid.	Readjust air gap.

112. Signal Tracing Notes

a. Signal tracing requires a source of af and rf signals. See paragraph 106 for a list of suitable test equipment.

b. In addition, a headset is necessary.

c. A tube tester and voltohmmeter are also needed to isolate the defective part after the faulty stage has been indicated.

d. Note the volume, and listen for serious distortion from the headset at the various points in the signal tracing procedure. If possible, compare with a unit known to be good.

e. Check the wiring and soldering in each stage during the procedure.

f. When trouble is localized to a stage, first test the tube if such a test is indicated; then measure the voltage at the tube socket terminals; and finally measure the resistance at the tube socket terminals (figs. 91 through 96).

g. Trouble in a circuit or stage may not cause changes in voltage and resistance measurements at the tube socket. The notes included in this paragraph are merely a guide and should suggest other procedures, such as voltage and resistance measurements on individual parts.

h. Remove only one tube at a time when testing. Check the number of the tube; test the tube and, if it is not defective, return it to its proper socket before another tube is removed.

i. At each step it is assumed that all previous steps were completed satisfactorily. Isolate and clear any trouble located before proceeding with succeeding steps.

113. Signal Tracing in Antenna Coupler CU–286/FRR–33

a. Signal tracing in the antenna coupler requires the use of Radio Receiver R–391/URR, or equivalent. Connect the output of channel A (J1348) to the receiver input (J108).

b. Place the BFO switch on the receiver front panel in the ON position.

c. Apply an rf signal to the input of channel A. Listen for an audio signal in headphones placed in the receiver

PHONES receptacle. If no audio signal is heard, try another band.

d. If no audio signal is heard on any band, check tube V1302 (fig. 30) and input and output wiring common to all bands of channel A.

e. If no audio signal is heard on any one band, check input transformer and switch wiring for that band. (Refer to main schematic, figure 123.)

f. A similar procedure may be followed for channel B.

114. Signal Tracing in Selector Control C–974/FRR–33

a. Place OFF-REMOTE-LOCAL switch S1402 in the REMOTE position and TONE INT-EXT switch S1401 in the INT position.

b. Set the ADJUST SENSITIVITY control (fig. 42) in maximum clockwise position.

c. Connect an accurately calibrated af signal generator to terminals 1 and 5 of terminal board TB1401 (fig. 43). Jumper terminals 2 and 4 of TB1401.

d. Apply a 1-volt signal of approximately 1,100 cps to the input, adjusting the signal generator for peak reading on a dc meter connected to pin 1 of tube V1403 (fig. 33).

e. The dc voltage at pin 1 of tube V1403 should be approximately +52 volts. If less voltage is present trouble is present in the two preceding impulse amplifier stages (V1401 or V1402A) or the rectifier stage (V1402B).

f. Audio signal should be present at pin 1 of tube V1402 (fig. 33). This signal may be monitored by using the headphone facilities of Electronic Multimeter ME–6A/U. If audio signal is not present, trouble is present in impulse amplifier stages, V1401 or V1402A.

g. Connect the multimeter lead to pin 2 of V1402. Audio volume should be less than at pin 1. A reading of approximately 1.6 volts ac should be obtained. If no audio signal is present, trouble is present in first impulse amplifier stage (V1401) or coupling circuit between impulse amplifiers.

h. Connect multimeter lead to pin 5 of tube V1401. A reading of approximately 2.8 volts ac should be obtained. If audio signal is not present, trouble is in first impulse amplifier (V1401).

i. Connect multimeter lead to pin 1 of tube V1401 (fig. 33). If no audio signal is present, input circuit to the selector control is defective. Approximately .084 volts ac should be obtained.

115. Signal Tracing in Remote Switching Control C–973/FRR–33

No signal tracing source voltage is necessary in the remote switching control, since the af oscillator provides its own check. Connect a 600-ohm resistor across terminals 1 and 5 of TB1201 (fig. 49), jumper terminals 2 and 4, and connect Electronic Multimeter ME–6A/U across the resistor. When dial S1201 is held open, a 1,105 cycle note should be heard in the monitor headphones of the multimeter. If no signal is heard, either the af amplifier (V1202) or oscillator (V1201) is defective. Connect the multimeter to pin 1 of V1202. If an audio note is now heard, the af amplifier is defective. If no audio signal is present the oscillator or coupling network is defective. With the output level adjusted to 2.45 volts, the following readings should be obtained: −34 vdc at pin 1 of tube V1201; 32 vac at terminal 2 of L1201; 2.4 vac at pin 1 of tube V1202; and 34 vac at pin 5 of tube V1202. These readings are obtained with the dial held in the operated position.

116. Stage Gain Measurements

a. Antenna Coupler CU–286/FRR–33. Gain measurements for the cathode followers in the antenna coupler are given in paragraph 128*d* (final testing of the antenna coupler).

b. Selector Control C–974/FRR–33. Gain measurements of the selector control are made under the following conditions: OFF-REMOTE-LOCAL switch in the REMOTE position, INT-EXT switch in the INT position, BAY PREFIX SELECTOR control in 07 position, ADJUST SENSITIVITY control in maximum clockwise position, CHAN. 1 and ANT. 1 selected, signal generator connected to terminals 1 and 5 of terminal board TB1401, terminals 2 and 4 of TB1401 jumpered, signal generator output frequency adjusted to 1,105 cps, and signal generator output adjusted to 25 millivolts.

Note. To adjust the signal generator to the proper frequency, connect the voltmeter to pin 1 of V1403 and adjust the signal generator for a maximum dc reading.

Voltmeter connection	Voltmeter reading
V1403, pin 1	+52 vdc
V1402, pin 2	1.6 vac
Junction of R1408 and R1409	2.6 vac
V1401, pin 5	2.8 vac
V1401, pin 1	.08 vac

c. Remote Switching Control C–973/FRR–33. The following gain measurements of the remote switching control are made with the dial held in the operated position and the output adjusted to +10 dbm (2.45 vac).

Voltmeter connection	Voltmeter reading
V1202, pin 5	34 vac
V1202, pin 1	2.4 vac
V1201, pin 1	−34 vdc
L1201, term. 2	32 vac

Section II. REPAIRS

117. General Precautions

Whenever equipment is to be serviced, be sure to observe the following precautions:

a. Be careful when the door at the rear of the rack is open and when covers are removed from component chassis; dangerous voltages are exposed.

b. Careless replacement of parts causes new faults to occur. Note the following points:

(1) Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections, tag each of the leads to it.

(2) Be careful not to damage other leads by pulling or pushing them out of the way.

(3) Do not allow drops of solder to fall into the set, since they may cause short circuits.

(4) A carelessly soldered joint may create a new fault. It is very important to make well-soldered joints, since a poorly soldered joint is usually difficult to find.

(5) When a part is replaced in rf or if. circuits, it must be placed exactly as the original one. A part which has the same electrical value but different physical size may cause trouble in high frequency circuits. Give particular attention to proper grounding when replacing a part. Use the same ground point as in the original wiring. Failure to observe these precautions may result in decreased gain or possibly in oscillation of the circuit.

118. Repairs in Antenna Coupler CU–286/FRR–33

a. Antenna Coupler Input Transformers (fig. 97). The twelve input transformers (T1301 through T1312) are designed for quick replacement. Each transformer is constructed as a plug-in unit and is held in place by two captive screws. To remove a transformer, insert a Phillips screwdriver into the holes in the transformer can and loosen the captive screws. Manually operate the tuning rack to its top position. Carefully push to one side the slug associated with the transformer being removed and work the transformer loose. To replace the transformer, reverse the procedure.

b. Removal of Autotune Units. The following instructions are given as a guide to the proper method of replacing an Autotune unit. A further breakdown is also shown in figure 76 and discussed in paragraph 82.

Note. For a discussion of the Autotone units in Radio Receiver R–391/URR, refer to the instruction book covering the radio receiver.

(1) Remove the front panel, using the following procedure.

(*a*) Remove the switch (OFF-REMOTE-ANT 1-ANT 2 switch) knob, using a No. 8 Bristo wrench.

(*b*) Remove the locking keys (3) from ANTENNA TUNING and TUNING RANGE controls.

(*c*) Remove the ANTENNA TUNING and TUNING RANGE knobs on the Autotune shafts, using a No. 8 Bristo wrench.

(*d*) With a Phillips screwdriver, remove the two screws holding the dial light assembly (fig. 97) in place and loosen the assembly.

(*e*) With a Phillips screwdriver, remove the four screws holding the front panel to the main chassis assembly.

(*f*) With a 3/8-inch open-end wrench remove the four nuts holding the handles in place.

(*g*) Remove the front panel from the main chassis.

(2) To remove an Autotune positioning head (fig. 74), loosen the three 5–40 screws holding the

unit in place and pull the unit forward. In removing the positioning head associated with the tuning rack (fig. 97), care must be taken that the floating part of Oldham coupler O1315 (fig. 109) either remains with the driven unit or is removed and carefully marked for exact replacement.

(3) To remove the Autotune control unit (fig. 74), disconnect plug J1349 (fig. 97) at the rear of the Autotune casting, loosen the three 5–40 screws holding the unit in place, and pull the unit forward.

c. Disassembly and Assembly of Autotune Positioning Heads.

(1) If it becomes necessary to disassemble an Autotune positioning head for any reason, the procedure outlined below should be followed. For illustration of the steps involved, refer to figure 104. For part names, refer to figure 105.

(*a*) Remove the insulation (29) and dust covers (27) from both sides of the Autotune unit by removing the eight dust cover screens (28).

(*b*) Remove the cam shaft nut (4) and lock washer (5) on the front end of the cam shaft (10), preventing the shaft from rotating with a No. 10 Bristo wrench inserted into the Bristo socket in the end of the shaft (refer to figure 104).

(*c*) Remove the safety wire (26) from the heads of the spring-anchor screws (25) on the bottom of the unit, and remove the screws.

1. Remove the pawl-shaft nut (21) and lock washer (20) at the rear of the unit.

2. Unscrew the pawl shaft (par. 82) by means of the Bristo socket (No. 10) on the front of the shaft.

3. Remove the spring-pawl assembly (13).

(*d*) Remove the front-plate assembly (6) after unscrewing the four Phillips-head screws (1) and lock washers (2) at the corners of the plate. Remove the felt oiler (7) and cam-shaft sleeve assembly (8) so that it does not fall off and become lost. (See B in figure 104.)

(*e*) The cam-drum assembly (9) may now be removed.

(*f*) The stop-ring-shaft assembly (12) may now be removed. Be careful not to misplace the ball bearing assemblies (11 and 14).

(*g*) To remove the cam shaft (10), carefully remove the snap-ring (19), snap-ring washer (18), and shims (17) at the rear end of the shaft. Remove the cam shaft, ratchet-pawl assembly (15), and shims (17) from the rear plate assembly (16). The ratchet-pawl assembly (15) may now be removed from the cam shaft (10).

Caution: Do not misplace or lose any of the shims (17), since it is important to replace the same number of shims at their previous location.

(*h*) To remove the upper or lower bearing-plate standoffs (23 or 24, respectively) from the rear plate assembly (16), remove the four screws (22) at the corners of the plate.

(2) The Autotune unit may now be reassembled by following the procedure given below.

(*a*) Replace upper and lower-bearing-plate standoffs (23 and 24).

(*b*) Insert the cam shaft (10) part way into the ratchet-pawl assembly (15), and with a pointed tool, lift the ratchet catch so that the cam shaft (10) may be pushed into the ratchet-pawl assembly (fig. 104C).

(*c*) Place the cam shaft (10) in its bearing in the rear plate assembly (16), replace the shims (17) and washer (18) on the end of the shaft, and carefully put the snap-ring (19) into place.

(*d*) Make certain the correct ball-bearing assemblies (11 and 14) are in place, then carefully replace the stop-ring-shaft assembly (12). The gear at the back of the assembly should mesh with its adjacent gear.

(*e*) Replace the cam-drum assembly (9) on the cam shaft (10). The end bearing an aluminum washer faces the rear of the unit.

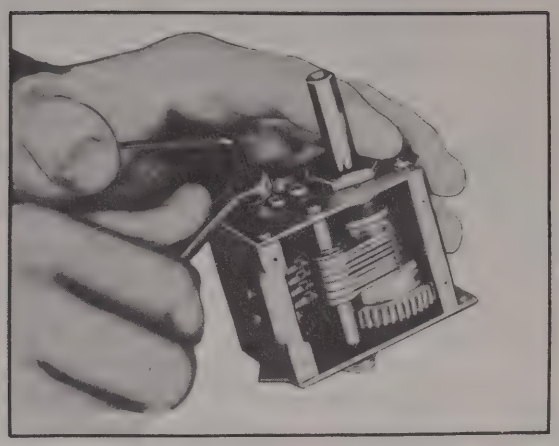
(*f*) Replace the felt oiler (7) and cam-shaft-sleeve assembly (18). The slotted end of the cam-shaft-sleeve assembly (8) bears against the cam-drum assembly (9).

(*g*) Carefully replace the pawls (par. 82) and screw the pawl shaft (par. 82) a short distance into the rear-plate assembly (16).

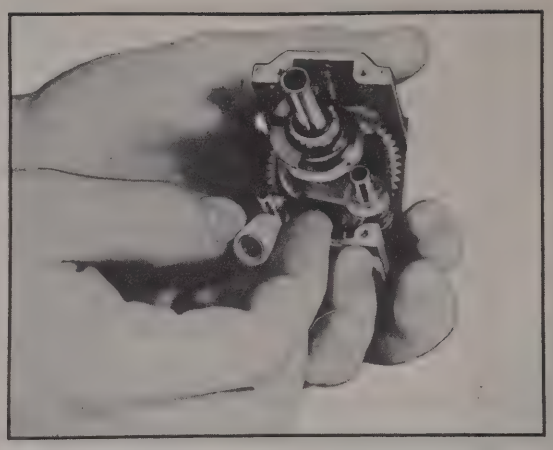
(*h*) Turn the stop-ring-shaft assembly (12) so that the stop on the home-stop ring is at the upper position.

(*i*) Replace the front-plate assembly (6).

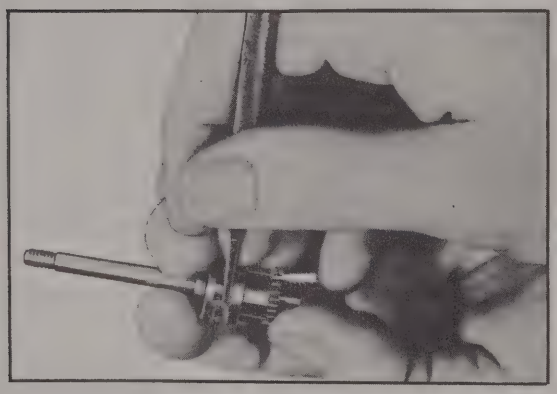
(*j*) Screw the pawl shaft into the back plate (16) until each pawl rests precisely on the center of its stop ring (fig. 104D). Replace the pawl-shaft nut (21) on the pawl shaft at the rear of the unit, holding the pawl



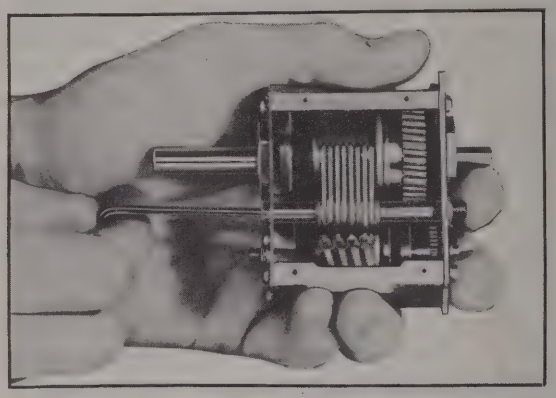
(A) REMOVING CAM SHAFT NUT



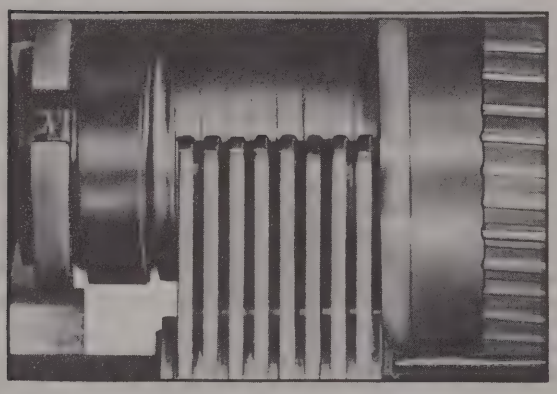
(B) POSITIONING HEAD, FRONT PLATE REMOVED



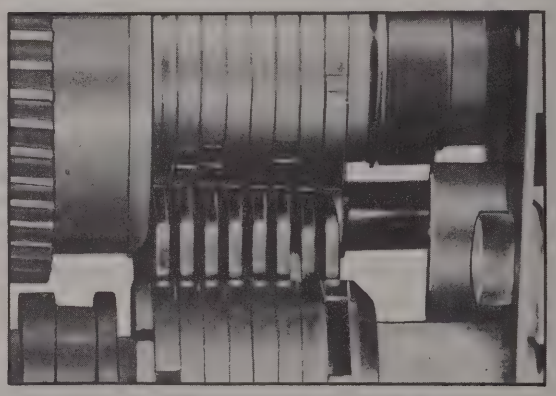
(C) INSERTING CAM SHAFT INTO RATCHET PAWL ASSEMBLY



(D) ALIGNING PAWL TOES WITH STOP RINGS



(E) PAWL TOES ALIGNED WITH STOP RINGS



(F) PAWL HEELS ALIGNED WITH CAM DRUM RINGS

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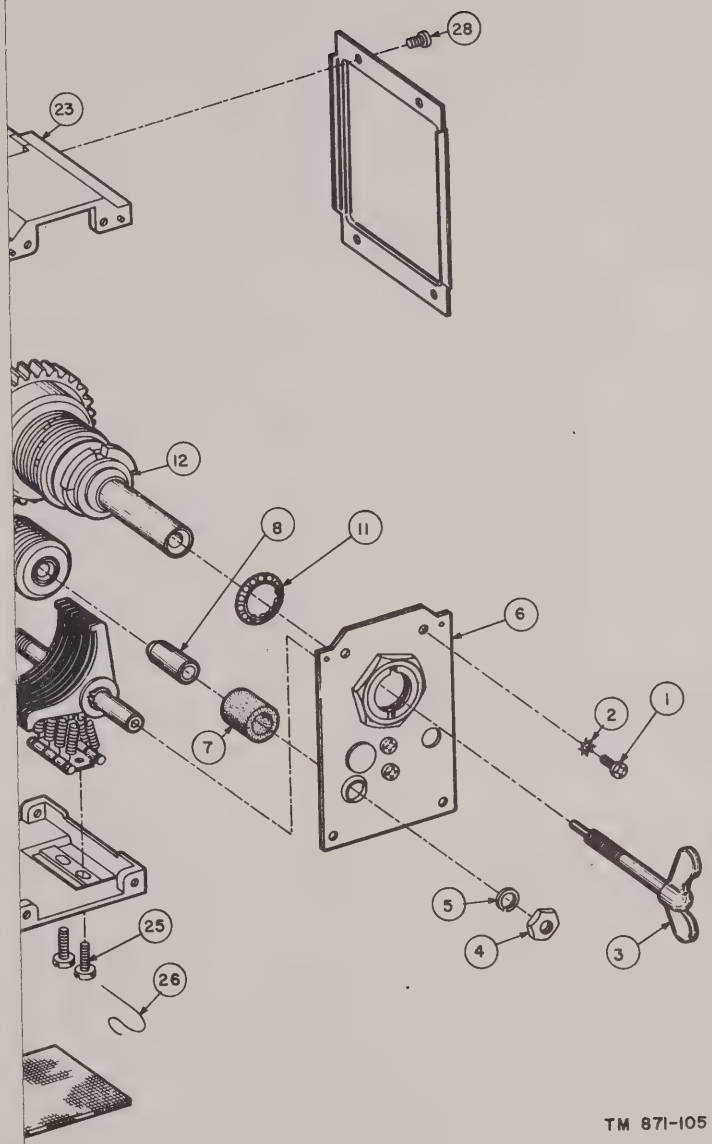
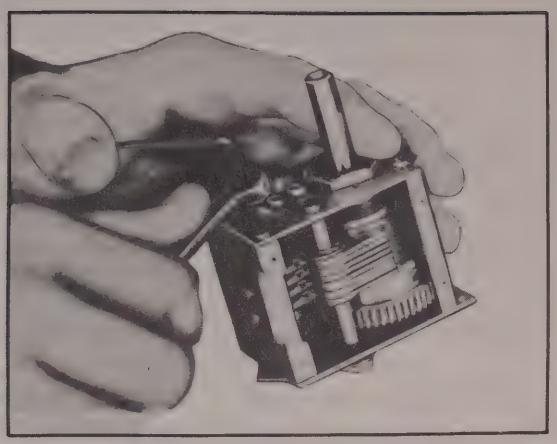
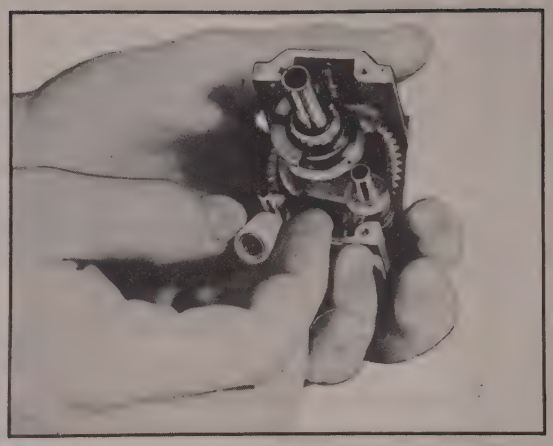
Figure 104. Antenna Coupler CU-286/FRR-33, Autotune positioning head, disassembly and assembly diagram.



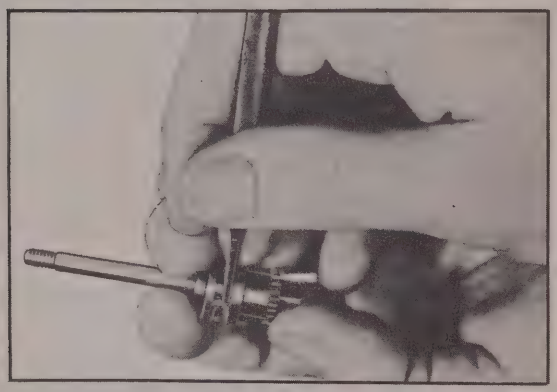
FRR-33, *Autotune positioning head, exploded view.*



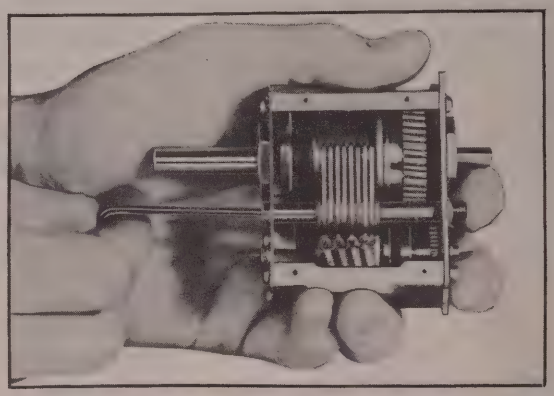
(A) REMOVING CAM SHAFT NUT



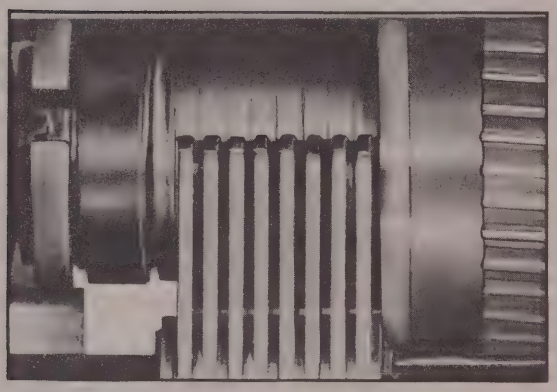
(B) POSITIONING HEAD, FRONT PLATE REMOVED



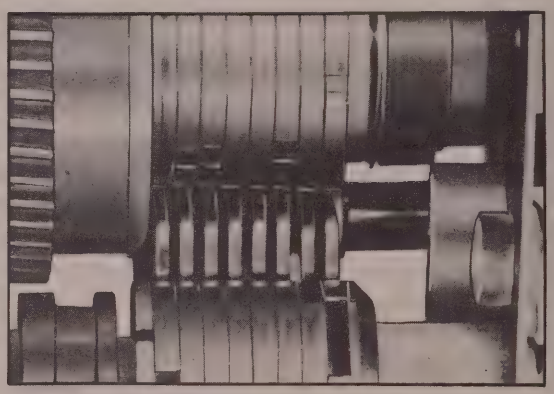
(C) INSERTING CAM SHAFT INTO RATCHET PAWL ASSEMBLY



(D) ALIGNING PAWL TOES WITH STOP RINGS



(E) PAWL TOES ALIGNED WITH STOP RINGS



(F) PAWL HEELS ALIGNED WITH CAM DRUM RINGS

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Figure 104. Antenna Coupler CU-286/FRR-33, Autotune positioning head, disassembly and assembly diagram.

1. PHILLIPS-HEAD SCREW
2. LOCK WASHER
3. LOCKING KEY
4. CAM-SHAFT NUT
5. LOCK WASHER
6. FRONT-PLATE ASSEMBLY
7. FELT OILER
8. CAM-SHAFT SLEEVE
9. CAM-DRUM ASSEMBLY
10. CAM SHAFT
11. FRONT BALL-BEARING ASSEMBLY
12. STOP-RING-SHAFT ASSEMBLY
13. SPRING-PAWL ASSEMBLY
14. REAR BALL-BEARING ASSEMBLY
15. RATCHET-PAWL ASSEMBLY
16. REAR-PLATE ASSEMBLY
17. SHIMS
18. SNAP-RING WASHER
19. SNAP-RING
20. LOCK WASHER
21. PAWL-SHAFT NUT
22. SCREW-AND-WASHER UNIT
23. UPPER BEARING-PLATE STANDOFF
24. LOWER BEARING-PLATE STANDOFF
25. SPRING-ANCHOR SCREW
26. SAFETY WIRE
27. DUST COVER
28. DUST-COVER SCREWS
29. INSULATION

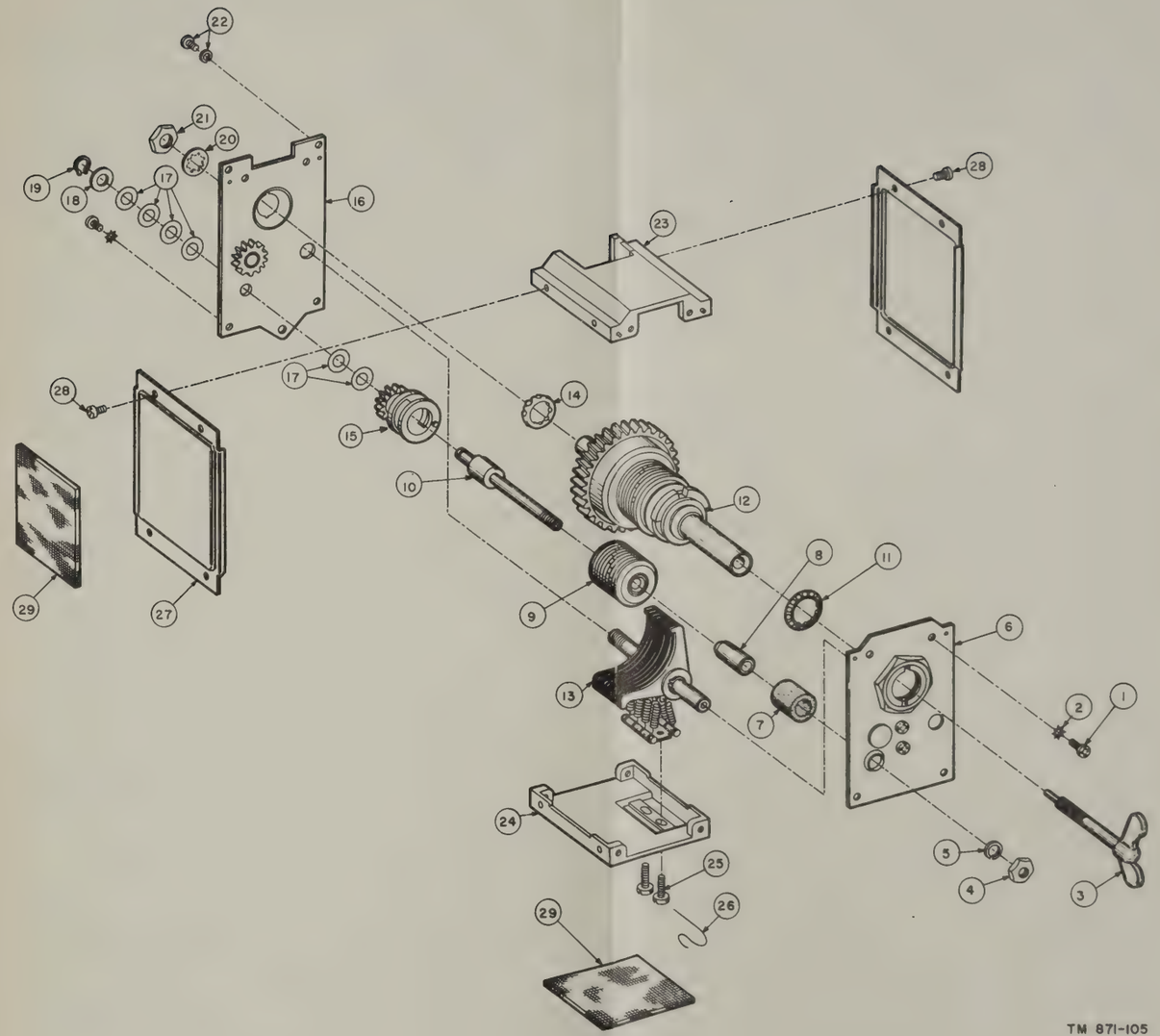

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Figure 105. Antenna Coupler CU-286/FRR-33, Autotune positioning head, exploded view.

shaft in front with a Bristo wrench to prevent the shaft from rotating as the nut is tightened (A of fig. 104). Check to see that the pawl toes are lined up with their respective cam-drum rings (see figures 104E and 104F).

(*k*) Replace the lock washer (5) and nut (4) on the front end of the cam shaft (10). Tighten the nut, at the same time holding the cam shaft in position with the Bristo wrench.

(*l*) Carefully manipulate the spring-anchor assembly (26) into position, and replace the spring-anchor screws (25), making sure the springs line up with the pawls. Tighten the screws securely. With approximately two inches of #22 wire, make a figure "8" loop through the heads of the screws and twist the ends of the wire together.

(*m*) Rotate the stop-ring drum (par. 82) to determine whether the slots in any stop ring (par. 82) fail to pass beneath their respective stop-ring pawl toes (par. 82). With a pointed tool, rotate any misalined rings so that the pawl toes may reach the slots. Apply circumferential pressure in the slot, being careful not to score the rings.

(*n*) Lubricate the unit according to instructions in paragraph 59.

(*o*) Replace the insulation (29) and the dust covers (27).

Note. Although most of the major assemblies in an Autotune positioning head can be removed and replaced by a competent repairman, no attempt should be made to further disassemble these parts.

d. Synchronization of Autotune Units. After replacement of an Autotune positioning head, it must be synchronized with the other units of the installation. The synchronizing procedure is outlined in the following subparagraphs. Synchronization is done before replacing the front panel.

(1) Replace ANTENNA TUNING and TUNING RANGE controls and locking keys. Do not lock the keys.

(2) Manually rotate the Autotune drive shaft (fig. 74) which couples all the Autotune units with the Autotune motor (fig. 74). Experimentally determine in which direction the shaft must be rotated to give an audible snap in the control unit. Stop rotation of the drive shaft as nearly as possible at the point where such a snap occurs.

(3) Rotate the drive shaft in the other direction $3\frac{1}{2}$ to $3\frac{5}{8}$ revolutions, and stop.

(4) Rotate both positioning heads (fig. 74) to home stop, first clockwise and then counterclockwise.

Note. Step (4) is performed to make certain that a stop-ring slot (par. 82) is engaged by a stop-ring pawl toe (par. 82) in each of the positioning heads. Test for this condition by tightening both locking keys. If either of the shafts rotate as its key is being tightened, the associated head does not have a stop-ring slot engaged by a stop-ring pawl toe, and it will be necessary to loosen all locking keys and repeat steps (1), (2), and (3) until none of the shafts will rotate when the locking keys are tightened.

(5) Insert a No. 10 Bristo wrench into the end of the positioning-head cam shaft (fig. 74) on one of the units. Without unduly forcing the wrench, rotate the shaft as far as possible clockwise. Hold the shaft in place and rotate the nut on the shaft counterclockwise $\frac{1}{4}$ to $\frac{1}{2}$ turn. Continue to rotate the shaft clockwise as far as possible without unduly forcing the wrench and tighten the nut. Repeat the procedure for the other Autotune positioning unit.

(6) Remove locking keys, ANTENNA TUNING control knob, and TUNING RANGE control knob.

(7) Replace the front panel, using a procedure the reverse of that given in paragraph 118*b* (1).

(8) Rotate the Autotune shafts fully counterclockwise.

(9) Replace and tighten both control knobs on their shafts.

(10) Replacement of the Autotune locking keys completes the synchronization procedure. If at any time, especially after repairs on Autotune mechanisms, the system does not cycle properly, the installation or one of the units may be out of synchronization, and the above procedure should be applied to the head or heads which do not cycle properly.

e. Disassembly and Assembly of Autotune Control Head.

Note. The procedure given below gives directions for disassembling the mechanical portions of the Autotune control head. Connecting wires should be unsoldered and tagged before removing any particular part of the unit.

(1) If it becomes necessary to disassemble the Autotune control unit, the procedure outlined below should be followed. For part names and

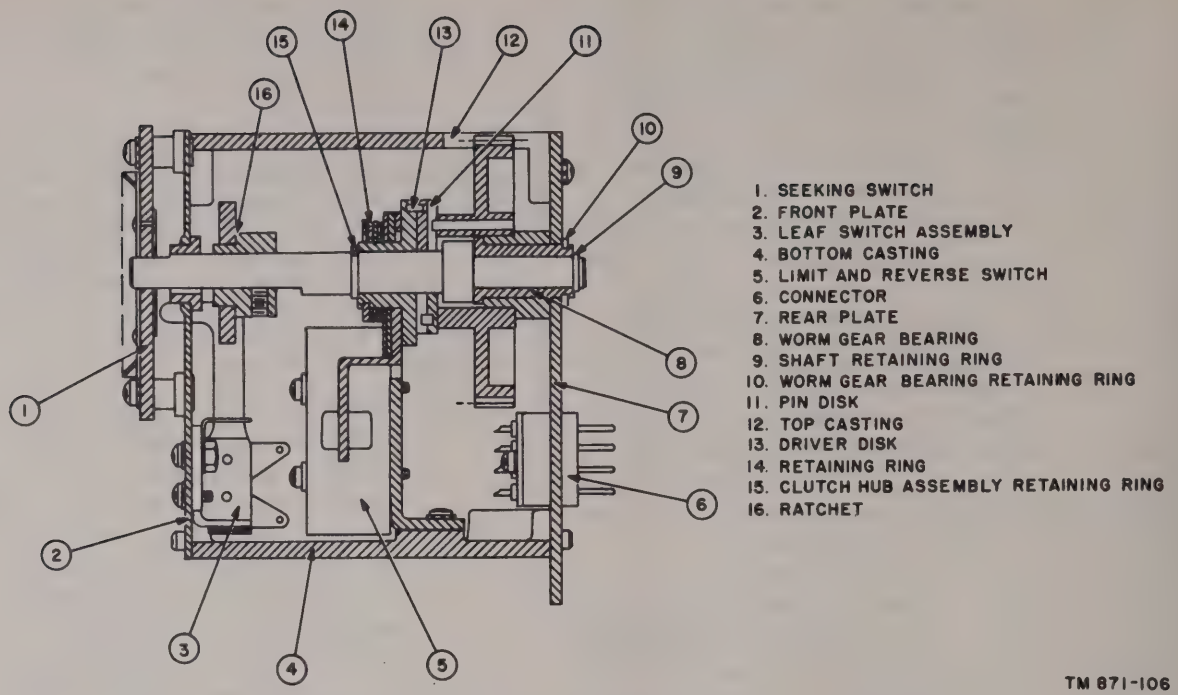


Figure 106. Antenna Coupler CU-286/FRR-33, Autotune control head, cross-sectional view.

item numbers, refer to figure 106.

(*a*) Remove the cover plates from both sides of the unit.

(*b*) Remove the two screws holding the seeking switch (1) in position and remove the switch.

(*c*) Remove the four screws holding the front plate (2) in position and remove the front plate.

(*d*) The leaf switch assembly (13) can now be removed from the front plate (2) if necessary. It is held in position by two screws.

(*e*) Loosen the four screws on the rear plate (7) and remove the top and bottom castings (12 and 4, respectively).

(*f*) The limit and reverse switches (5) can now be removed from the bottom casting (4) by loosening two screws. Separate screws hold each switch on the switch mounting plate.

(*g*) Remove the retaining ring (9) holding the shaft in position and pull the shaft assembly out of its bearing (8).

(*h*) To further disassemble the shaft assembly, use the following procedure:

1. Loosen the set screws holding the ratchet (16) in place and remove the ratchet.

2. Remove the retaining ring (15) and pull the clutch hub assembly from the shaft. The clutch hub assembly can be further disassembled by removal of the retaining ring (14) holding the various parts in position.

3. Remove the driver disc (13) and pin disc (14) from the shaft.

(*i*) To remove the worm gear bearing (18) mounted on the rear plate (7), it is only necessary to remove the retaining ring (10) holding it in position.

(*j*) The connector (6) is held in place by two screws and may be removed if necessary.

(2) To assemble the Autotune control head, follow steps (*a*) through (*j*) in a reversed procedure. Two precautions are necessary:

(*a*) When replacing the clutch hub assembly on the shaft, the ratchet spring should be held open with a small pointed instrument while inserting the clutch hub assembly into the ratchet gear.

(*b*) When replacing the front cover, the leaf switch assembly should be pulled back slightly to allow the leaf switch to clear the ratchet wheel without damage.

(3) After disassembly and repair of an Autotune control head, oil and lubricate according to instructions given in paragraph 59.

(4) Replace the Autotune control head and synchronize the Autotune system according to the procedure given in subparagraph *d* above.

f. Removal of Autotune Motor. If removal of Autotune motor B1301 (fig. 74) becomes necessary, a ¼-inch open-end wrench must be used to remove the two cap screws holding the motor in place. One of the cap screws is partially hidden by gear O1304 (fig. 109). Before attempting to remove the motor, tag and unsolder the connections on the rear of the motor.

119. Repairs in Selector Control C–974/FRR–33

a. Autopositioner Repair and Adjustment. Part names and item numbers are given in figure 107.

(1) Operation without control unit. To operate the Autopositioner without a control unit, press the relay (24) armature to step the mechanism around to the desired position.

(2) Autopositioner relay adjustment. When it becomes necessary to adjust Autopositioner operating relay K1415 (24) without removing it from the unit, proceed as follows:

(*a*) Loosen relay mounting screws (1).

(*b*) With pawl (23) engaged in a notch of the stop-wheel (22), hold the pawl (23) fully seated in the notch.

(*c*) Rotate the relay (24) clockwise about the mounting screws so that the relay frame and armature contact the pawl (23) projection to eliminate all lost motion of the relay (24).

(*d*) Tighten relay mounting screws (1) in this position.

(*e*) Depress the relay armature and check to see that the pawl (23) lifts clear of the notch to allow free rotation of the stop-wheel (22). The pawl should clear the stop-wheel teeth by approximately 1/64 inch. More than 1/32-inch clearance indicates excessive relay travel with a corresponding loss of power. Relay travel can be adjusted, if necessary, by loosening the two screws near the relay hinge and sliding the hinge plate up or down slightly as required.

(*f*) The motor-operating contacts on the relay (24) should be adjusted to maintain contact when the pawl (23) is resting on top of a stop-wheel (22) tooth between positions with the relay de-energized. This is to ensure that the motor (8) will continue to drive until the pawl engages the proper notch, which opens the contacts at least .025 inch. Contacts can be adjusted, if necessary, by bending the stationary contact arm.

(3) Autopositioner relay replacement and adjustment. If for any reason it is necessary to replace an Autopositioner relay and aline it, the following procedure should be used.

(*a*) Seat the pawl (23) in a notch of the stop-wheel (22). Turn the gear train (12) by hand to allow the pawl to seat fully.

(*b*) Place the relay so that the pawl finger comes between the relay spring and frame at about the middle of the spring.

(*c*) Line up the mounting hole farthest from the pawl and start this mounting screw (1), without applying any pull to the relay spring. That is, let the relay (24) turn clockwise slightly.

(*d*) Turn the relay counterclockwise about this screw. This will let the pawl finger slide between the spring and relay arm. Start the second screw.

(*e*) Hold the pawl fully seated in the stop-wheel notch and hold the relay frame against the pawl finger. Tighten mounting screws. See that the pawl is fully seated and that the relay armature and arm have no free play. Reposition if necessary to meet these conditions.

(*f*) Depress the relay armature and turn the Autopositioner manually or under power and check the clearance between the pawl tip and the stop-wheel. This should be approximately 1/64 inch or less. If adjustment is necessary, loosen the two screws near the hinge point and slide the hinge plate up or down as required. Adjustment may be aided by placing a .020 inch feeler gauge between the armature and coil core. Be careful that the relay arm does not rub on the frame or against the stop-wheel.

(*g*) Check the operation of the motor contacts. With power off, depress armature and arm should have a small amount of free play to permit full contact pressure at the contact points.

(*h*) If necessary, bend the stationary contacts in or out. Failure to make contact in this position may allow the Autopositioner to set up

at the wrong position with the seeking switch open, but with the pawl between notches. Excessive free play of the armature in this position indicates insufficient contact opening in the energized position.

(4) *Clutch maintenance.*

(*a*) To gain access to the clutch (16), remove the Truarc retaining ring (1) using Truarc pliers and slide the gear (13) off the shaft (21).

(*b*) To remove the clutch from the drum (16), press the ends of the clutch toward each other, using wire bending pliers, and slide the clutch out of the drum (16).

(*c*) To remove the clutch drum (16) from the shaft (2), remove the retaining ring (11) with pliers and while holding the shaft (do not use pawl (23) to hold shaft), loosen the nut (14) with pliers or a wrench and proceed to slip the spacer (15) and drum from the shaft.

Caution: Do not use pawl (23) to hold shaft (21). Doing so may bend pawl or shear pawl pivot pin (20).

(*d*) Before replacing the clutch ring in the drum (16), carefully wipe the inside of the drum to remove oil and grease. Inspect the drum surface for scoring.

(*e*) Lubricate the bearing in the mounting plate (17) with a drop of MIL–L–644A oil.

(*f*) The number of metal springs within the clutch shoe and the resilience of the metal springs determines the torque of the clutch. The Autopositioner should have a torque of 5 to 5½ inch pounds to function properly.

Caution: Exercise care in the reassembly of the clutch drum (16) to the shaft (2). The retaining nut (14) must be tightened sufficiently to insure against slippage.

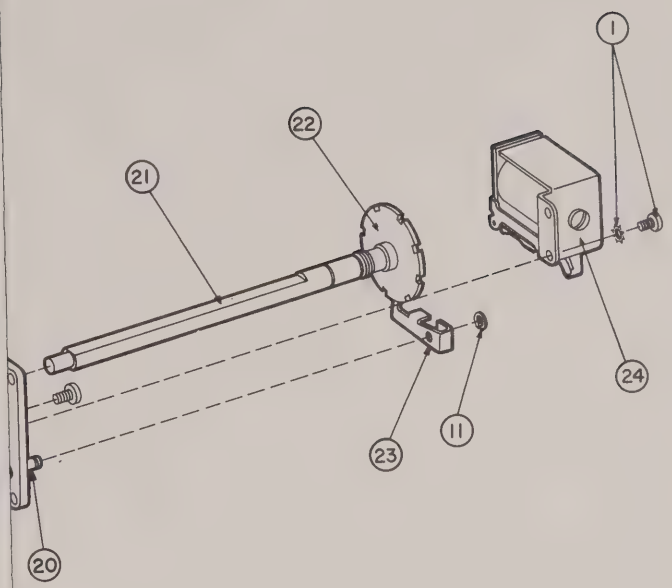
(*g*) Reassemble the Autopositioner and make adjustment of the relay (24) as outlined above in subparagraphs (1) and (2).

(5) *Autopositioner motor repair.* Autopositioner motor B1401 (8) is mounted beneath the top plate (10) of the Autopositioner assembly. Three screws (1) hold the motor in position.

(*a*) When the brushes are worn to less than 1/4 inch in length they should be replaced. To replace a brush, unsolder the brush lead, lift the spring off of the brush, remove the brush, and replace it with a new one.

(*b*) To replace the Autopositioner motor (8), unsolder the two power leads, remove the three screws (1) holding the motor to the top mounting plate (10), and remove the motor. Mount the new motor in reverse order.

(6) *Synchronization of Autopositioner switches.* Synchronization of the Autopositioner switches (5) can be made by visual inspection. Alinement is not critical, but the switches should be positioned so that the blade segments are well centered on the switch positions. The unit should be run under power and each switch stack checked at several positions to eliminate any errors caused by backlash and eccentricity.



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74/FRR-33, Autopositioner, exploded view.

at the wrong position with the seeking switch open, but with the pawl between notches. Excessive free play of the armature in this position indicates insufficient contact opening in the energized position.

(4) *Clutch maintenance.*

(*a*) To gain access to the clutch (16), remove the Truarc retaining ring (1) using Truarc pliers and slide the gear (13) off the shaft (21).

(*b*) To remove the clutch from the drum (16), press the ends of the clutch toward each other, using wire bending pliers, and slide the clutch out of the drum (16).

(*c*) To remove the clutch drum (16) from the shaft (2), remove the retaining ring (11) with pliers and while holding the shaft (do not use pawl (23) to hold shaft), loosen the nut (14) with pliers or a wrench and proceed to slip the spacer (15) and drum from the shaft.

Caution: Do not use pawl (23) to hold shaft (21). Doing so may bend pawl or shear pawl pivot pin (20).

(*d*) Before replacing the clutch ring in the drum (16), carefully wipe the inside of the drum to remove oil and grease. Inspect the drum surface for scoring.

(*e*) Lubricate the bearing in the mounting plate (17) with a drop of MIL–L–644A oil.

(*f*) The number of metal springs within the clutch shoe and the resilience of the metal springs determines the torque of the clutch. The Autopositioner should have a torque of 5 to 5½ inch pounds to function properly.

Caution: Exercise care in the reassembly of the clutch drum (16) to the shaft (2). The retaining nut (14) must be tightened sufficiently to insure against slippage.

(*g*) Reassemble the Autopositioner and make adjustment of the relay (24) as outlined above in subparagraphs (1) and (2).

(5) *Autopositioner motor repair.* Autopositioner motor B1401 (8) is mounted beneath the top plate (10) of the Autopositioner assembly. Three screws (1) hold the motor in position.

(*a*) When the brushes are worn to less than 1/4 inch in length they should be replaced. To replace a brush, unsolder the brush lead, lift the spring off of the brush, remove the brush, and replace it with a new one.

(*b*) To replace the Autopositioner motor (8), unsolder the two power leads, remove the three screws (1) holding the motor to the top mounting plate (10), and remove the motor. Mount the new motor in reverse order.

(6) *Synchronization of Autopositioner switches.* Synchronization of the Autopositioner switches (5) can be made by visual inspection. Alinement is not critical, but the switches should be positioned so that the blade segments are well centered on the switch positions. The unit should be run under power and each switch stack checked at several positions to eliminate any errors caused by backlash and eccentricity.

1. SCREW AND WASHER UNIT
2. NUT AND WASHER UNIT
3. END-PLATE ASSEMBLY
4. SWITCH SPACER
5. SWITCH WAFER
6. SPACING POST
7. MOUNTING SCREW
8. MOTOR
9. MOTOR GEAR AND PIN
10. TOP PLATE
11. RETAINING RING
12. DRIVE GEAR
13. AUTOPOSITIONER GEAR
14. NUT
15. SPACER
16. CLUTCH AND DRUM
17. AUTOPOSITIONER MOUNTING PLATE
18. STUD
19. RELAY MOUNTING PLATE
20. PAWL PIN PIVOT
21. AUTOPOSITIONER SHAFT
22. STOP WHEEL
23. PAWL
24. RELAY

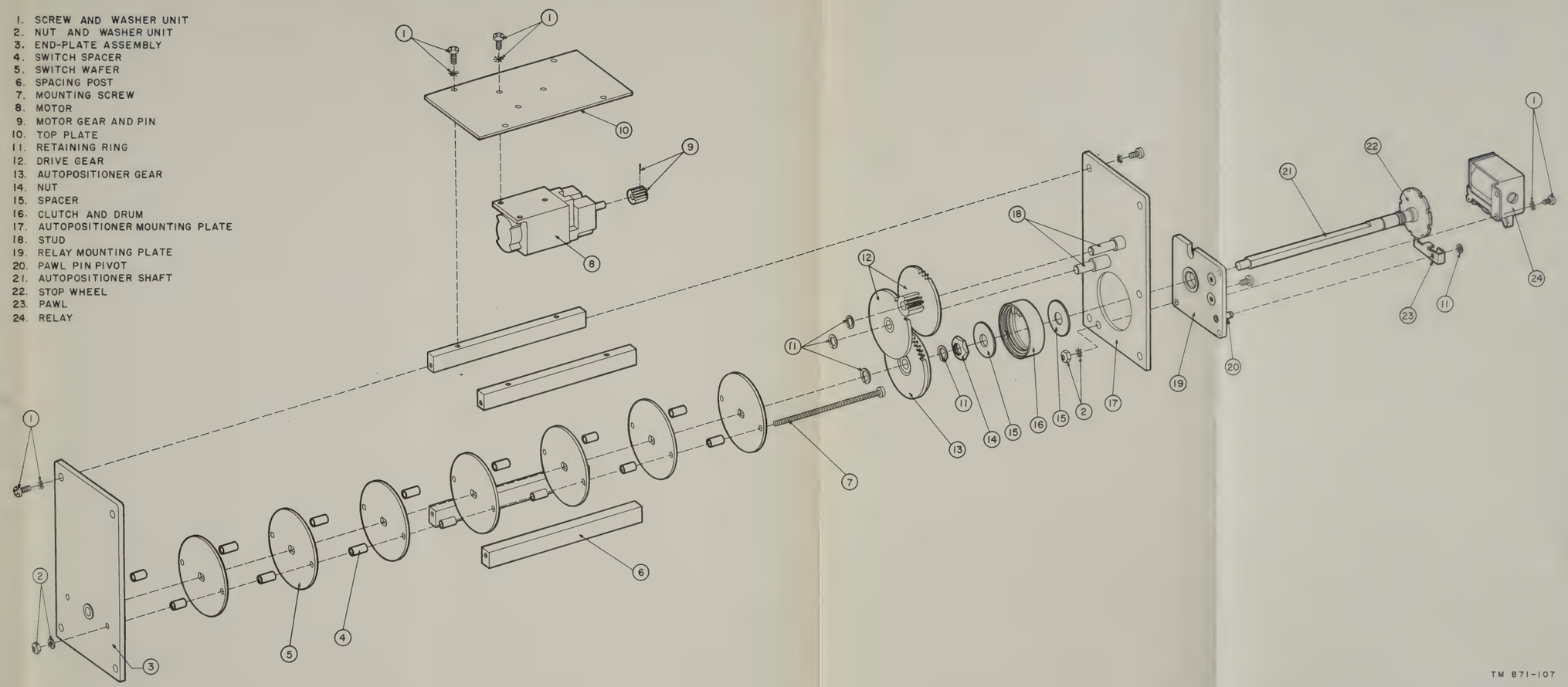

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Figure 107. Selector Control C-974/FRR-33, Autopositioner, exploded view.

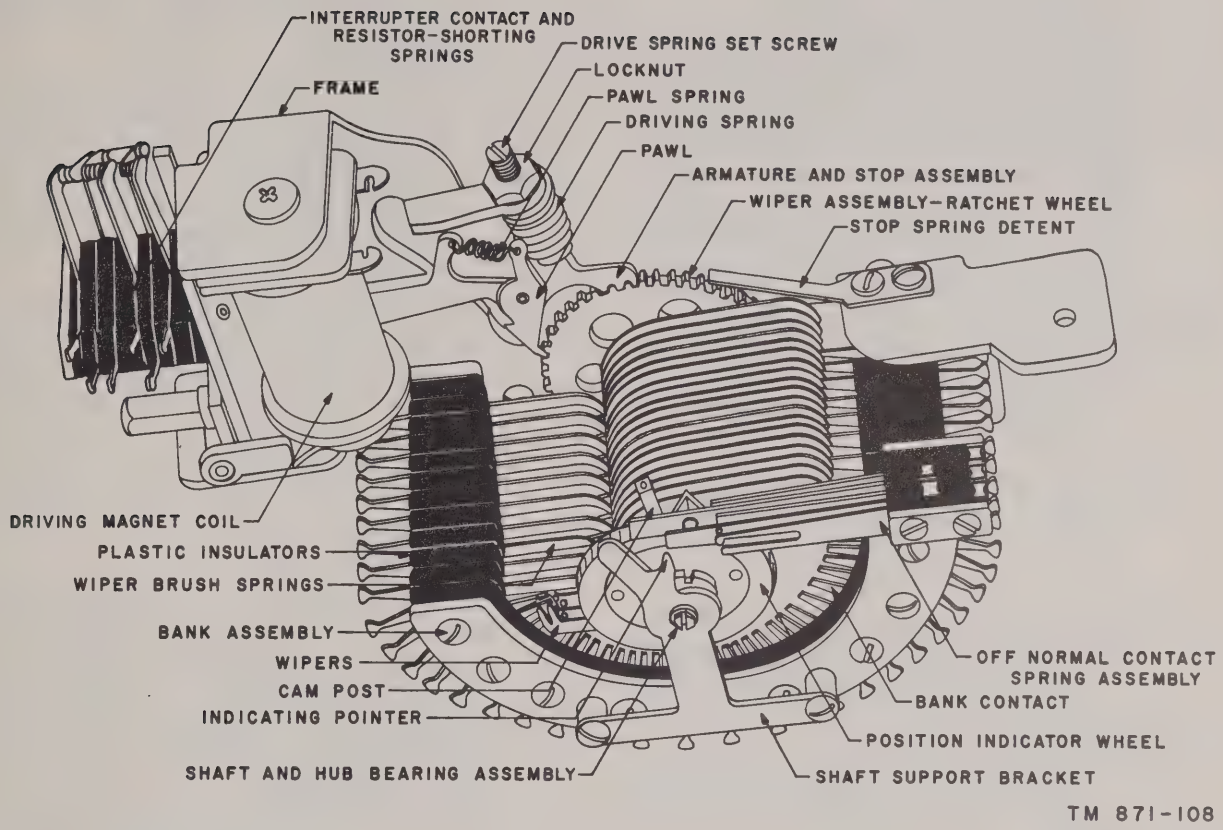


Figure 108. Selector Control C-974/FRR-33, stepping relay K1402, assembly details.

b. Relay K1402 Repair and Adjustment. Relay K1402 should be inspected and adjusted, if necessary, according to the following procedure. The only two adjustments that normally require adjustment are the tension of the driving spring and gaging of the interrupter springs. Tension of the driving spring is controlled by a micrometer screw, while the interrupter spring adjustment is a simple gap setting to obtain smooth self-interrupted stepping. An illustration identifying parts is given in figure 108.

Note. The auxiliary contacts (interrupter contact and resistor-shorting springs) of relay K1402 in equipments with serial numbers 1 through 5 may require maintenance more often than those in later equipments. These contacts are made of tungsten rather than palladium. Inspect the contacts frequently and burnish them when necessary.

(1) *Brush springs.* The brush springs, which are part of the bank assembly, should rest against the inner hub of the wipers with sufficient tension to ensure good electrical contact as the wiper assembly rotates.

(*a*) The brush springs (wiper terminal springs) should be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be separated approximately 1/2 inch.

(*b*) When assembled in the wiper assembly the two springs shall lie close and lie flat against each other to within 1/32 inch from the angle near the spring end.

(*c*) In general, the brush springs will not require adjustment during the life of the relay. If it

does become necessary to readjust them, the armature must first be removed by loosening the two yoke mounting screws and the wiper assembly must be taken out by loosening the shaft mounting hex nut and two shaft support screws. Extreme care should be taken when reassembling the relay so as to avoid damaging the brushes or wipers.

(2) *Wipers.* The wipers should have sufficient tension to insure good electrical contact with the bank contacts and should be alined so as to pass on to the base of the brushes without excessive sidewise motion. The wiper assembly should turn freely on its shaft with the shaft mounted in the frame and the shaft support bracket firmly tensioned against the shoulder of the shaft.

(*a*) The wiper pairs should be alined so that they pass onto the base of the brushes without excessive movement (1/64 inch) to one side or the other.

(*b*) Each spring of a non-bridging wiper pair should be tensioned to follow approximately 3/32 inch measured at the tip when its opposing spring is deflected.

(*c*) With the wipers resting on the bank contacts, there should be a minimum clearance of 1/16 inch between the wiper springs of adjacent wiper pairs.

(*d*) The indicator should point to the number or line on the indicator wheel corresponding to the bank contact on which the wipers are resting.

(3) *Armature.* When the armature is operated, its pawl is positioned in the next tooth of the ratchet wheel. A coil-type spring restores the armature when the magnet is de-energized, rotating the wiper assembly on contact, after which the stopping teeth on the armature engage the ratchet wheel teeth. For proper operation there must be no binds in the armature assembly.

(*a*) The armature should clear the heelpiece, and a .003-inch gage should be tight and a .0015-inch gage should be loose in the air gap with the armature electrically operated.

(*b*) The pawl tip should rest against the ratchet wheel with a pressure of 130 grams minimum, 150 grams maximum with the armature in an unoperated position.

(4) *Ratchet-stopping spring.* The ratchet-stopping spring is provided to hold the wiper assembly in place while the armature pawl is being prepared for the next step.

(*a*) The ratchet-stopping spring should be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the curve near the tip of the spring.

(*b*) With the play between the pawl and ratchet wheel taken up in the direction opposite to wiper rotation and the armature in unoperated position, there shall be perceptible to .003-inch maximum clearance between the spring tip and the radial surface of the ratchet tooth.

(5) *Bank.* The bank is attached to the frame by nuts screwed onto several of the bank assembly screws which project through the frame. The mounting holes in the frame are slotted, providing circumferential adjustment only of the bank position relative to the frame. The edge of the non-bridging wipers should lie on the center third of the contacts when the bank is properly positioned.

(6) *Armature driving spring.* A coil-type spring restores the armature when the magnet is de-energized, driving the wiper assembly. An adjustment screw and locknut are provided. The armature should completely restore from operated position when retarded by hand and allowed to restore slowly.

(7) *Interrupter springs.* The interrupter springs are actuated by an arm on the armature of the switch. To insure trouble-free life and correct operation the contact pressures must be maintained and also the position of the armature in its stroke when the springs make or break contact.

(*a*) The armature arm should strike the lever spring brush centrally.

(*b*) Contacts should not be out of alinement (judged visually) by more than 1/5 of their face diameter, and should make contact at approximately the center of their faces.

(*c*) Break springs should have a contact pressure of 275 grams minimum, 400 grams maximum. When there are two sets of rotary-interrupter break springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure.

(*d*) There should be a minimum of .001-inch difference between the "break" and "make" gaging of any break-make combination.

(*e*) Contact gap on make or break springs should be .008-inch minimum.

(8) *Off-normal springs.*

(*a*) The apex of the V form of the main lever spring should line up approximately with the center line of the off-normal actuating bushings on the 26th step, and either edge should not be closer than 1/32 inch to the edge of the bushing. The V form should clear the bushing on the 25th and first steps by a minimum of .010 inch with the wiper assembly play taken up in the direction of the spring form.

(*b*) The armature spring of a break combination should have a contact pressure of 35 grams minimum, 50 grams maximum against the break spring as measured at the end of the armature spring.

(*c*) Make and break springs should have a minimum contact separation of .008 inch.

(*d*) Both contacts of a pair should make or break within .001 inch of each other as gaged visually.

(*e*) Break contacts should break contact before make springs make contact.

(*f*) Make springs should have a minimum total contact pressure of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make spring.

120. Refinishing

Instructions for rustproofing and touch-up painting are given in paragraph 64. Instructions for refinishing badly marred panels are given in technical manual TM 9–2851, Painting Instructions for Field Use.

Section III. ALINEMENT PROCEDURE

121. Test Instruments Used for Alinement and Adjustment

a. Rf Signal Generator. The rf signal generator should be an accurately calibrated instrument capable of producing output over the frequency range of .455 to 32 mc. A minimum of 1 volt is required. Output should be calibrated in volts. RF Signal Generator Set AN/URM–25, or equal, is satisfactory.

b. Rf Voltmeter. The rf output of the signal generator must be measured when alineing the antenna coupler. The voltage to be measured is 1 volt. Use Electronic Multimeter TS–505/U, or equal.

c. Dc Voltmeter. A dc voltmeter is needed to set the B+ voltages in the various units of the radio receiving set. Multimeter TS–297/U, or equal, is satisfactory.

d. VTVM. To adjust the output of the remote switching unit to the proper level a vtvm calibrated in ac volts is necessary. Use Electronic Multimeter ME–6A/U.

122. Calibration of Signal Generator

Correct alinement of the antenna coupler requires accurate calibration of the signal generator. If a frequency meter is used to check the calibration the following procedure may be used:

a. Place the signal generator and frequency meter near each other.

b. Turn on both equipments and allow them to warm up for at least 15 minutes.

c. Attach a piece of wire to the signal generator output connection and place the wire near the frequency meter output.

d. Calibrate the frequency meter according to instructions furnished with the meter; set the frequency meter to the exact frequency at which the signal generator is to be used.

e. Listen to the headset of the frequency meter as the signal generator is tuned. A zero beat should be obtained.

f. The signal generator is now set to the exact frequency desired. Turn off the frequency meter and remove the wire attached to the signal generator output.

Note. This procedure may vary slightly with various frequency meters. Refer to the instruction book furnished with the frequency meter.

123. Alinement and Adjustment of Antenna Coupler CU–286/FRR–33

The antenna coupler is factory-adjusted and will, under most conditions, require no readjustment for long periods of time. In the event that alinement and adjustment

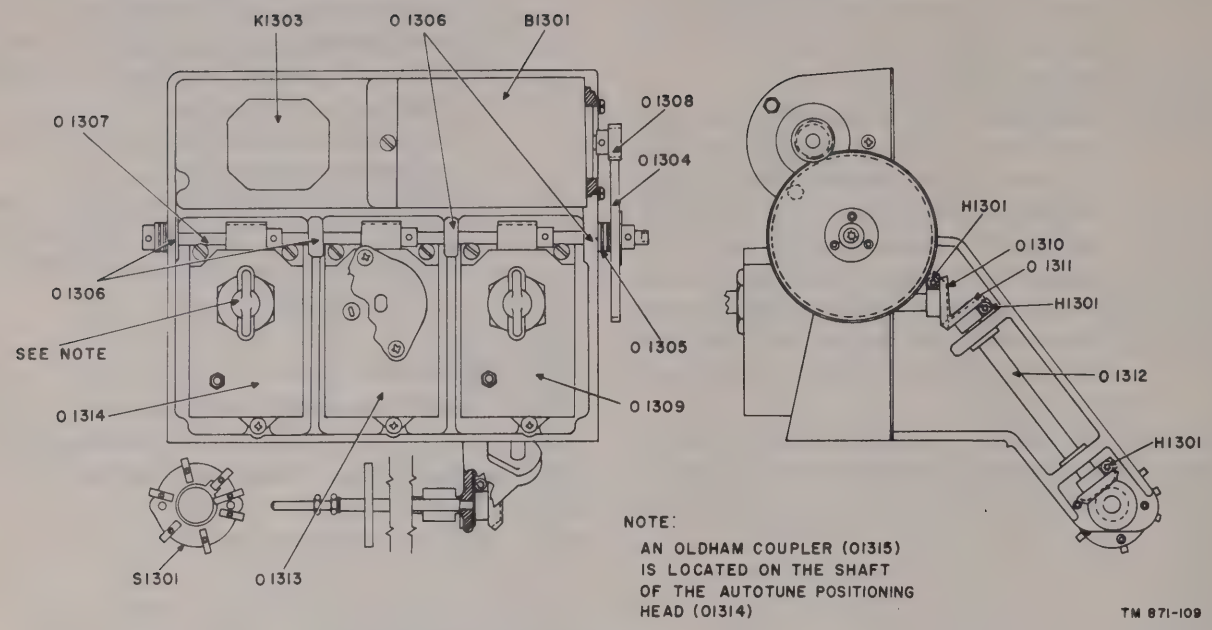


Figure 109. Antenna Coupler CU-286/FRR-33, Autotune assembly, location of mechanical alinement points.

do become necessary, however, the following procedure should be used.

a. Mechanical Alinement.

(1) Rotate the switch rotors of S1301 to the position shown in figure 109.

(2) Loosen the gear clamp on O1310 (fig. 109) and rotate the Autotune stop-ring shaft (fig. 105) as far as possible in the clockwise direction. Now rotate the stop-ring shaft (fig. 105) approximately 15 degrees in the counterclockwise direction. This procedure sets the bandswitch.

(3) Set range dial I 1302 in the 16.0–32.0 mc position with the calibration mark on the dial alined with the indicator mark. To adjust the dial, two set screws (located on the mounting flange of the dial) must be loosened with a No. 8 Bristo wrench, the dial rotated to position, and the set screws retightened.

(4) To aline the rack (fig. 97) with its Autotune unit the following procedure must be used:

(*a*) Loosen Oldham Coupler O1315 (fig. 109) on the Autotune stop-ring shaft (fig. 105) and turn the stop-ring shaft clockwise to the stop.

(*b*) Set the tuning rack (fig. 97) so that it has just reached the maximum rise position and tighten coupler O1315 (fig. 109).

Caution: Care must be taken in these adjustments so that the cam does not reach its maximum counterclockwise position before the Autotune unit does. If this should occur, the cam and cam-follower will be subjected to excessive wear.

(5) To aline the tuning dial I 1303 (fig. 97), turn ANTENNA TUNING control clockwise to the stop, loosen the two set screws on the dial mounting flange, aline the 1.0 mc mark (on the .5 to 1.0-mc scale) with the lower right side of the window, and retighten the set screws.

b. Electrical Alinement (fig. 110).

(1) Connect the antenna coupler to a source of variable ac voltage.

(2) Measure the ac voltage at B+ CHECK test jack J1344, using Electronic Multimeter ME-6A/U, or equivalent.

(3) Adjust the variable ac power source for 128 volts ac input.

(4) Set B+ ADJUST potentiometer R1314 for a ripple voltage of .1 volt ac at B+ CHECK test jack J1344. (The dc voltage should then fall within an approximate range of 180 to 200 volts with normal ac input.)

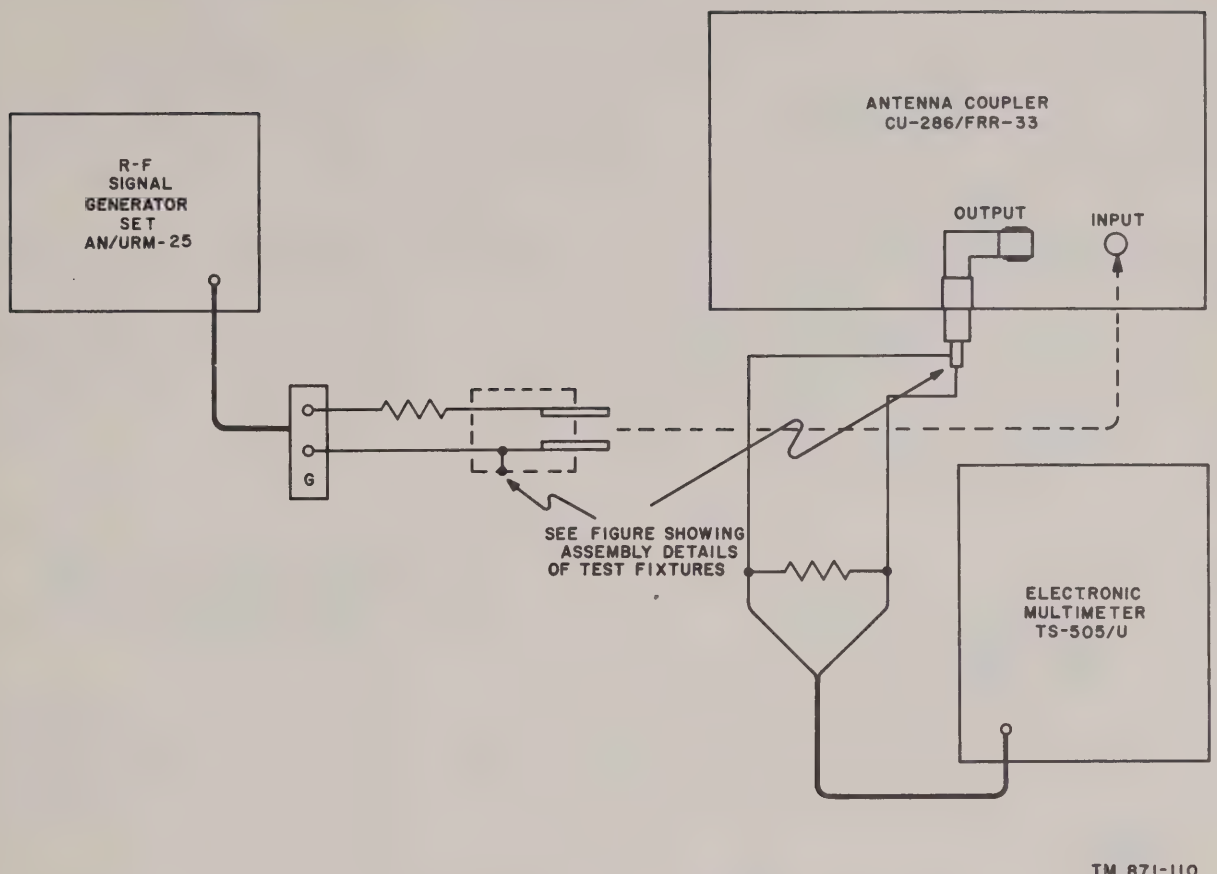


Figure 110. Antenna Coupler CU-286/FRR-33, alinement set-up.

(5) Set the tuning slugs to the position shown in figure 111A.

(6) Set all transformer trimmer capacitors to the half-capacity position as shown in figure 111B.

(7) Select the No. 1 band (.5 to 1.0 mc) and tune to the low end of the band. (This is accomplished by loosening the locking key and manually rotating the TUNING RANGE and ANTENNA TUNING controls.

(8) Connect a 120-ohm resistor across the output of channel A, using the test fixture shown in figure 112B. The UG–971/U connector should plug into J1348. Place an rf voltmeter across the resistor.

(9) Connect the signal generator to the ANT 1 input of channel A, using the adapter shown in A of figure 112, and apply a 500-kc signal of 1-volt amplitude to the input.

(10) Adjust the tuning slug of transformer T1307 (fig. 97) until the lower-limit range dial (I 1302) calibration corresponds to a peak reading on the rf voltmeter.

(11) Tune to the high-limit dial calibration (1.0 mc) and check against the signal generator frequency. If the antenna coupler covers too great a range, turn the slug adjustment screw a few turns counterclockwise and realine at the low end using the trimmer capacitor. Recheck the high end.

(12) If the antenna coupler covers too short a range, turn the slug adjustment screw a few turns clockwise and repeat the procedure of step (10).

(13) Repeat the above procedure until dial calibration is correct at both high and low limits for each band.

(14) Repeat for channel B.

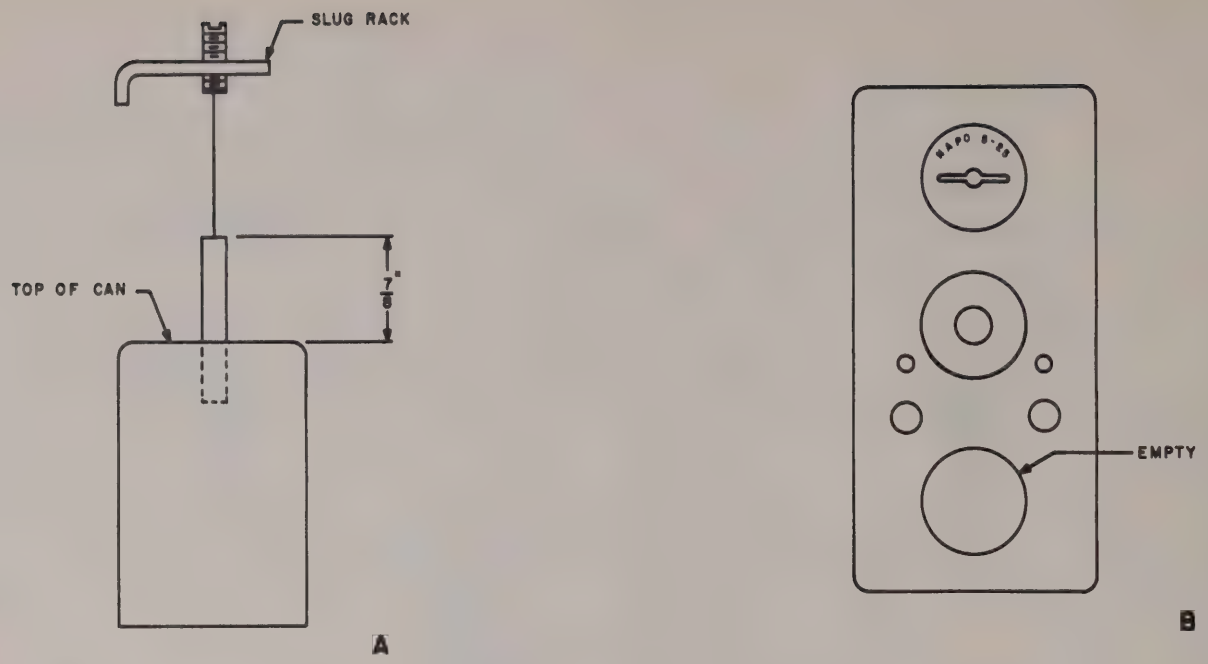

SLUG RACK
TOP OF CAN
7/8"
A
EMPTY
B
NOTE:
SET TUNING CONTROL SO SLUGS ARE AS FAR OUT OF THE COIL AS THE STOPS WILL ALLOW, AND ADJUST FOR 7/8 INCH OF SLUG OUT OF COIL.
NOTE:
TO SET COIL TUNER TO HALF CAPACITY, PRINTING ON TUNER MUST BE AS SHOWN.
TM 871-111

Figure 111. Antenna Coupler CU-286/FRR-33, positioning of antenna transformer parts for alinement.

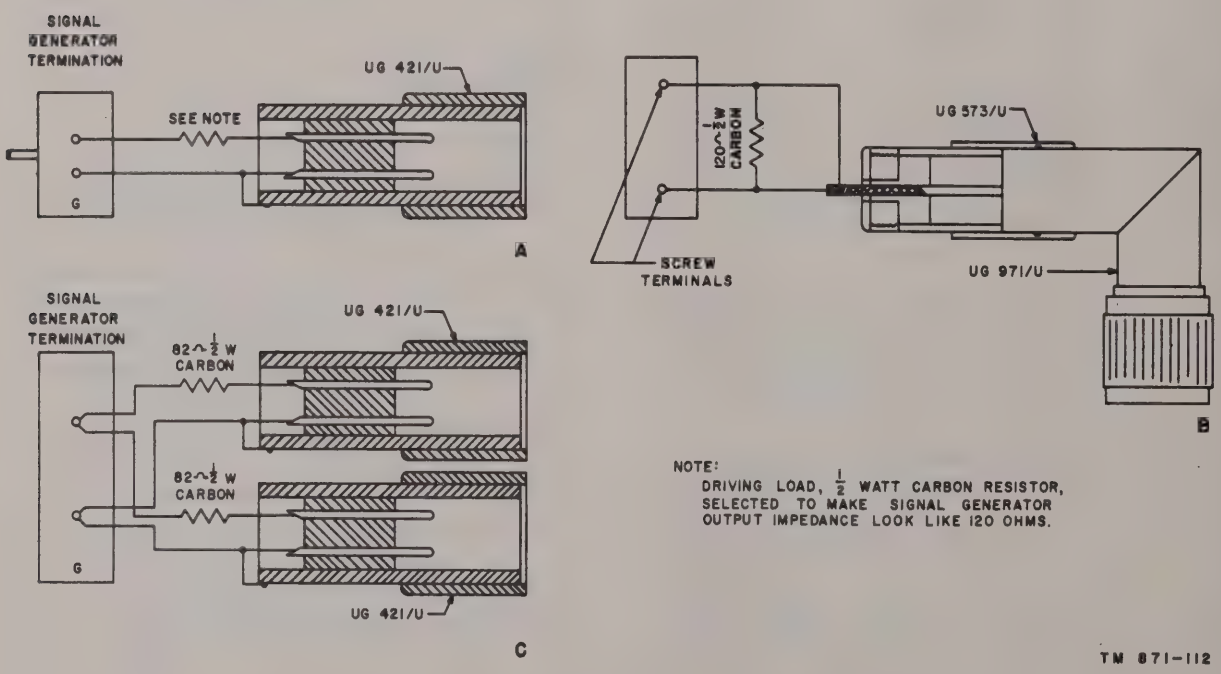


Figure 112. Antenna Coupler CU-286/FRR-33, test fixtures, assembly details.

124. Alinement and Adjustment of Selector Control C–974/FRR–33

a. Make the following settings of selector control switches:

Switch	Position
OFF–REMOTE–LOCAL INT–EXT	REMOTE INT

b. Connect the output of a properly adjusted Remote Switching Control C–973/FRR–33 to terminals 1 and 5 of terminal board TB1401 (fig. 99). Jumper terminals 2 and 4 of TB1401. Set ADJUST SENSITIVITY control R1402 so that output from the remote switching control will just cause operation of stepping relay K1402 (fig. 100).

c. Adjust the BAY PREFIX SELECTOR indicator-dial (fig. 42) to give the proper indication. The indicator dial may be adjusted by loosening two set screws with a No. 8 Bristo wrench, moving the dial to the proper position, and retightening the set screws.

d. Set B+ ADJUST control R1403 (fig. 99) for an output of 220 volts at test jack J1472 (fig. 99).

125. Alinement and Adjustment of Remote Switching Control C–973/FRR–33

a. Make the following settings of the controls:

Switch	Position
OFF–STDBY–ON TONE EXT–INT Dial S1201	ON INT Hold in operated position

b. Adjust B+ voltage control R1221 (fig. 102) to give an output of 220 volts measured at pin 3 of tube socket XV1205 (fig. 103).

c. Connect a 600-ohm resistor and Electronic Multimeter ME–6A/U across terminals 1 and 5 of terminal board TB1201 (fig. 103). Jumper terminals 2 and 4. Hold dial S1201 in an operated position and adjust OUTPUT LEVEL control R1205 (fig. 102) to give an output of 0 dbm (.775 volts).

Section IV. FINAL TESTING

126. General

This section is intended as a guide to be used in determining the quality of a repaired Radio Receiving Set AN/FRR–33 or any of the individual components of which it is composed. The minimum test requirements outlined in paragraphs 128 through 131 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

127. Test Equipment

The instruments needed for testing the repaired equipment are listed below:

a. Two Electronic Multimeters TS–505/U.
b. Spectrum Analyzer TS–723/U.
c. RF Signal Generator Set AN/URM–25.
d. Audio Oscillator TS–382A/U.
e. Multimeter TS–297/U.
f. Electronic Multimeter ME–6A/U.
g. Frequency Meter FR–67/U.

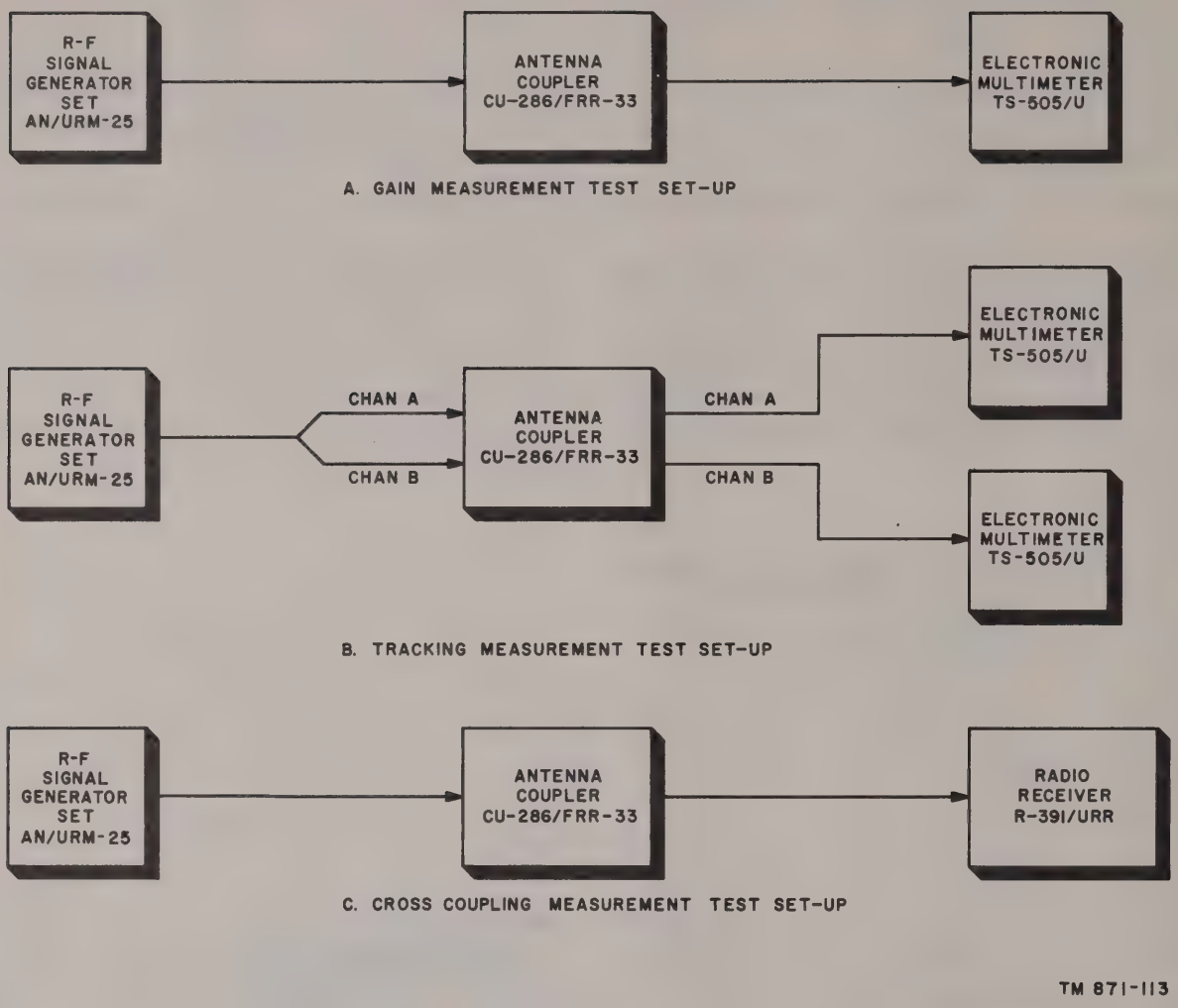


Figure 113. Antenna Coupler CU-286/FRR-33, final test set-up.

128. Final Testing of Antenna Coupler CU–286/FRR–33

a. Alinement. Refer to paragraph 123 and check mechanical and electrical alinement of antenna coupler.

b. Gain (fig. 113A). Check gain at the following three points on each band: low end of band plus 5 percent, center of band, and high end of band minus 5 percent. Gain is measured as follows:

(1) Connect a 120-ohm resistor across each output circuit, using the test fixture shown in figure 112B. Plug test fixture into receptacle J1348 for channel A and J1347 for channel B.

(2) Connect the rf signal generator, modified as in figure 112A, to CHAN. A ANT. 1 input receptacle J1338 (fig. 39). Feed in a 1-volt signal at each of the three frequencies.

(3) Measure the output voltage developed across the 120-ohm resistor in each case.

(4) Repeat for each band.

(5) Repeat for each antenna input (J1339, J1340, and J1341).

(6) Antenna gain can then be determined from the following equation:

$$\text{Gain} = \frac{2 \times E_{out}}{E_{in}}$$

(7) The gain should fall within the limits of .4 to 1.0 volts from .5 to 30 mc and within the limits of .35 to 1.0 volts from 30 to 32 mc.

c. Tracking (fig. 113B).

(1) Connect the signal generator to ANT 1 inputs of both channel A and channel B (J1338 and J1340), using the test fixture shown in figure 112C.

(2) Connect a 120-ohm resistor across each output circuit (J1347 and J1348), using two of the test fixtures shown in figure 112B.

(3) Connect an rf voltmeter across each resistor.

(4) Feed a 1-volt signal from the signal generator.

(5) Tune the antenna coupler to the low-end test point (low end of band plus 5 per cent) of the .5- to 1.0-mc band.

(6) Tune the signal generator for peak output reading in channel A output. Record the output reading of channel B.

(7) Retune the signal generator for peak output reading in channel B. Record the output reading of channel B.

(8) Repeat for the center and high-end (high end of band minus 5 per cent) test points.

(9) Repeat for each band.

(10) Tracking error is defined as follows:

$$\text{Tracking error (in db)} = 20 \log \frac{\text{Channel B output voltage with signal generator peaked for maximum channel B output.}}{\text{Channel B output voltage with signal generator peaked for maximum channel A output.}}$$

(11) Tracking error should be less than 1 db in all cases.

d. Cross Coupling (fig. 113C).

(1) Connect the output of channel A (J1348) to the input of a Radio Receiver R–391/URR.

(2) Connect the signal generator to the ANT 1 input of channel A (J1338).

(3) Feed a 10 uv signal into the antenna coupler.

(4) Note the reading of the CARRIER LEVEL meter mounted on the front panel of the radio receiver.

(5) Connect the output of channel B to the receiver input.

(6) Increase the signal input from the signal generator until the CARRIER LEVEL meter indicates the same level as that in step (4).

(7) Record the output voltage of the signal generator.

(8) Repeat for each of the three test points on all bands.

(9) Cross-coupling is defined as follows:

$$\text{Cross coupling (in db)} = \frac{\text{Voltage reading in step (7)}}{10 \text{ uv}}$$

(10) Cross coupling should exceed 35 db in all cases.

e. Power Supply Voltages. If possible, vary the input voltage to the antenna coupler from 98 to 132 volts. Measure the voltages indicated in the table below.

Voltage	Limits
B+ (B+ CHECK test jack J1344)	Approx. 180–200 volts dc.
Ripple (B+ CHECK test jack J1344)	Adjusted to .1 volt ac with 128 vac input
Relay supply (terminal 10 of relay K1301)[a]	8 ± 3 volts dc

[a] The negative return of rectifier CR1301 must be grounded when making this measurement. Place OFF-REMOTE-ANT. 1—ANT. 2 control (fig. 38) to ANT. 2 to accomplish this.

129. Final Testing of Selector Control C–974/FRR–33

a. Alinement. Refer to paragraph 116 and make the required adjustments. Leave switches in position.

b. Sensitivity of Remote Control Channel.

(1) Connect the output of a Remote Switching Control C–973/FRR–33 to the input of the selector control. (Connect terminals 1 and 5 of terminal board TB1201 (fig. 49) to terminals 1 and 5 of terminal board TB1401 (fig. 43). Jumper terminals 2 and 4 of each terminal board.) The output level of the remote switching control should previously be set to give an output level of −30 dbm (.0245 volts across 600 ohms). Since the minimum level of the remote switching control is −10 dbm (.245 volts across 600 ohms), a 600-ohm pad with 20 dbm attenuation must be used to obtain proper output.

(2) Set ADJUST SENSITIVITY control R1402 (fig. 42) in the maximum clockwise position.

(3) The selector control should operate with signal input from the remote switching control.

(4) Adjust the output level of the remote switching control to +10 dbm (2.45 volts across 600 ohms) and set ADJUST SENSITIVITY control R1402 in the maximum counterclockwise position.

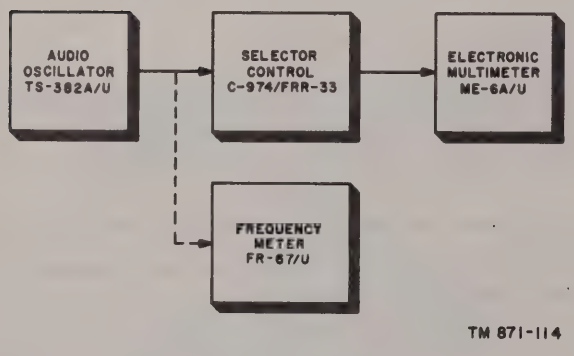


Figure 114. Selector Control C-974/FRR-33, final test set-up.

(5) The selector control should operate with signal input from the remote switching control.

(6) Set ADJUST SENSITIVITY control R1402 so that the output of the remote switching control just operates stepping relay K1402.

(7) All switching functions must be accomplished with remote operation.

c. Filter FL1401 Check (fig. 114).

(1) Connect the af signal generator to terminals 1 and 5 of TB1401 (fig. 43) and jumper terminals 2 and 4.

(2) Connect a dc voltmeter to pin 1 of V1403.

(3) Apply a 1-volt signal to the input.

(4) Adjust the input frequency for peak reading of the voltmeter.

(5) Measure the frequency of the signal generator output using the frequency meter.

(6) This frequency should fall within the range of 1080 to 1130 cps.

d. Power Supply Voltages.

(1) With a 15 per cent variation in line voltage from the nominal 115 volts, ac ripple voltage measured at test jack J1472 (fig. 99) with Electronic Multimeter ME–6A/U, or equivalent, should not exceed .1 volt.

(2) With the same variation in line voltage, the relay power supply voltage furnished by rectifier CR1401 should measure between 26.6 and 29.4 volts in the following position: CHAN 1, ANT 1, and ON. This voltage may be measured at pin 1 of relay K1408 (fig. 100).

130. Final Testing of Power Supply PP–629/URR

Connect the power supply to a 115-volt source and measure the output voltage at the + terminal of TB1101. Under no-load conditions this voltage should measure between 24.1 and 26.7 volts dc.

131. Final Testing of Remote Switching Control C–973/FRR–33

a. Alinement. Refer to paragraph 125 and make the required adjustments. Leave the switches in position.

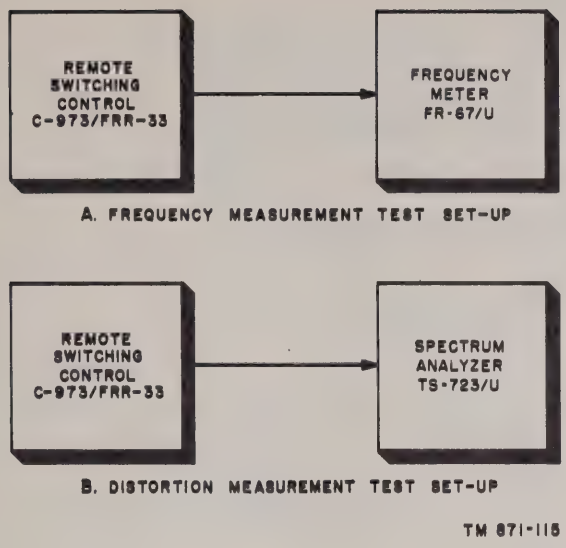


Figure 115. Remote Switching Control C-973/FRR-33, final test set-up.

b. Af Output (fig. 115).

(1) Connect a 600-ohm resistor across output terminals 1 and 5 of TB1201. Jumper terminals 3 and 4.

(2) Connect Frequency Meter FR–67/U across the 600-ohm resistor.

(3) Hold dial S1201 in the operated position and measure the output frequency of the unit.

(4) Connect a distortion meter such as Spectrum Analyzer TS–723/U across the 600-ohm resistor.

(5) Adjust OUTPUT LEVEL control R1205 (fig. 102) for a +10 dbm (2.45 volt ac) output.

(6) Measure the distortion of the output signal with the output adjusted to +10 dbm (2.45 volts ac). Distortion should be less than 7 per cent.

(7) Using the VU (volume unit) meter of the spectrum analyzer, check the output level at the clockwise and counterclockwise limits of OUTPUT LEVEL control R1205. Output level should vary between a minimum range of −10 dbm (.245 volt) and +10 dbm (2.45 volts).

Note. 0 VU is equivalent to +0 dbm.

(8) Connect an oscilloscope across the 600-ohm resistor. Observe the waveshape of the output during dialing on the vertical plates of an oscilloscope. No evidence of dirty dial contacts or other spurious keying effect should be present.

c. External Dial Contacts. Place TONE EXT-INT switch S1202 (fig. 102) in EXT position. Connect an ohmmeter across terminals 1 and 2 of TB1205. The ohmmeter should indicate intermittent contacts during dialing.

d. Tuning in Progress Indicator. Operate the dial. Measure the time TUNING IN PROGRESS lamp I 1202 (fig. 102) remains on, starting at the instant the dial comes to rest. This time should not be less than 17 seconds.

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND STORAGE

132. Disassembly

The circumstances involved in shipment and storage vary and no definite procedure can be given. The following instructions are intended as a guide for preparing the radio receiving set for shipment and storage.

a. Remove all outside leads such as antennas or ground wires.

b. Disconnect all external cabling.

c. Remove any headsets.

d. Remove each unit from the cabinet.

133. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the materials available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 19 of this manual and follow in reverse order the instructions given.

b. Whenever practicable, place a dehydrating agent such as silica gel inside the container. Seal the seams of the paper barrier with a waterproof sealing compound or tape. Pack the sealed equipment in a wooden case provided with at least 3 inches of excelsior padding between the barrier and the wooden case.

Section II. DEMOLITION OF MATERIAL TO PREVENT ENEMY USE

134. General

The demolition procedures outlined in paragraph 135 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon the order of the commander.

135. Methods of Destruction

a. Smash. Smash the meters, controls, tubes, coils, switches, capacitors, transformers, and headsets, using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut cords, headsets, and wiring, using axes, handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals, using gasoline, kerosene, oil, flame throwers, incendiary grenades.

d. Bend. Bend panels, cabinet, and chassis.

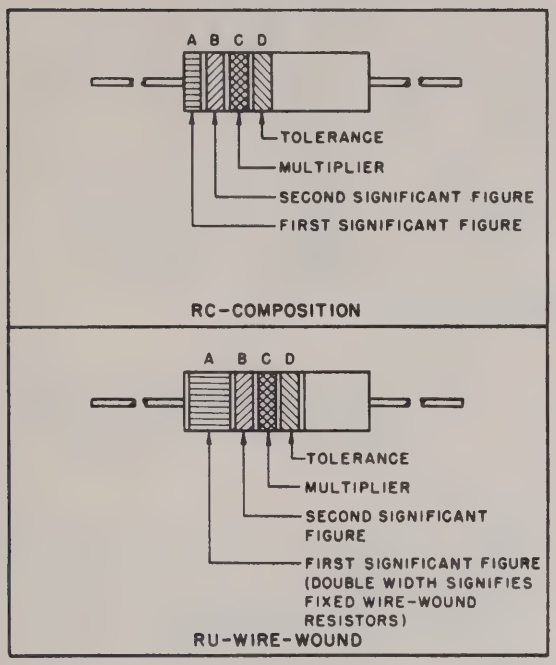
e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

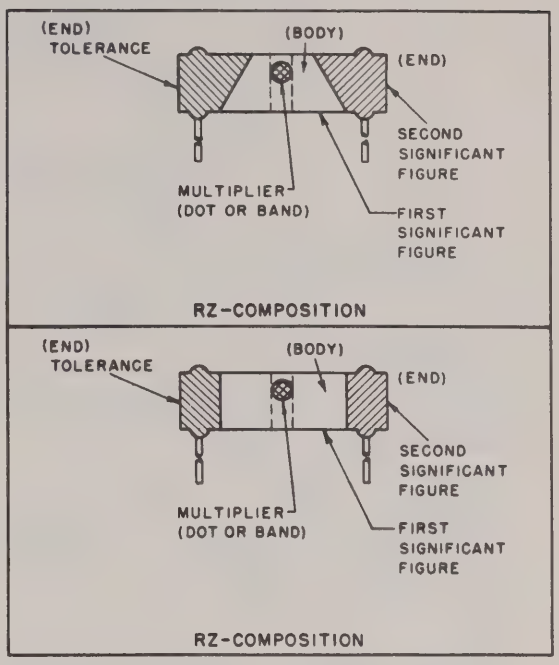
g. Destroy everything.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

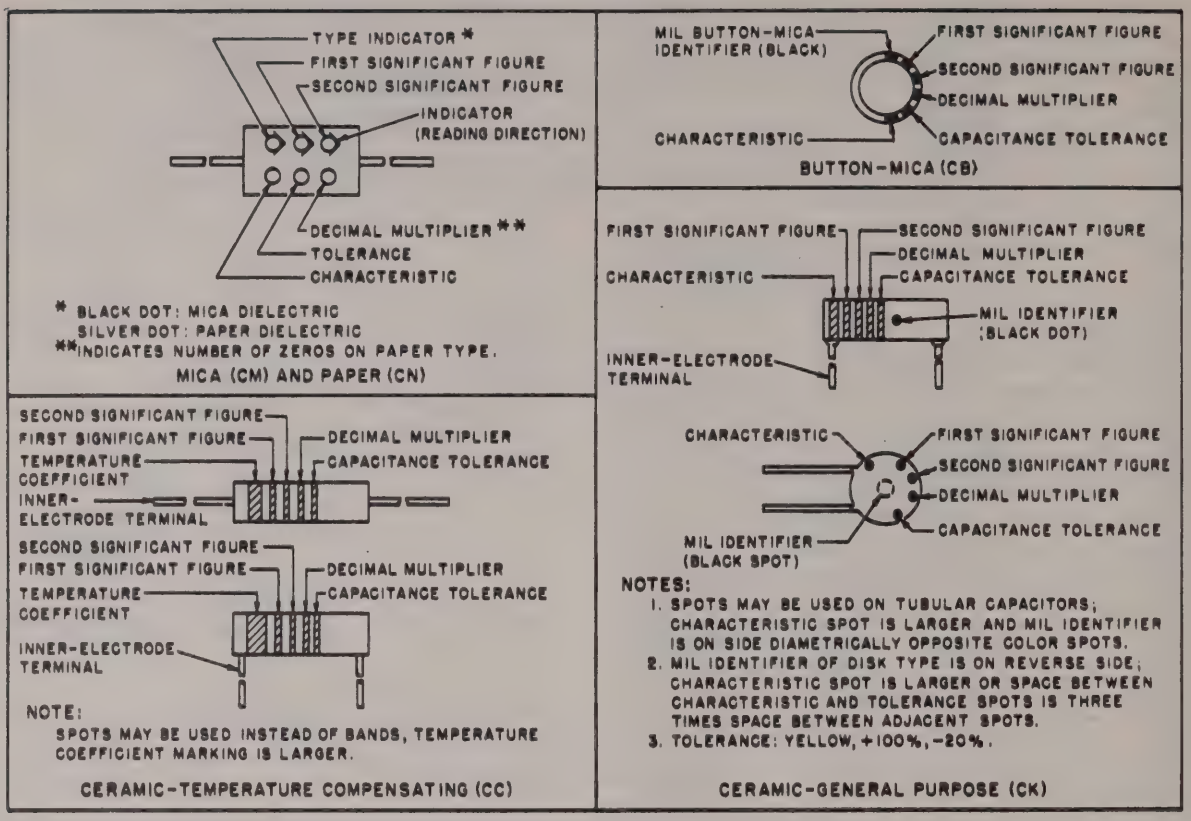
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-R1

Figure 116. Resistor color codes.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE[2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500) [3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 117. Capacitor color codes.

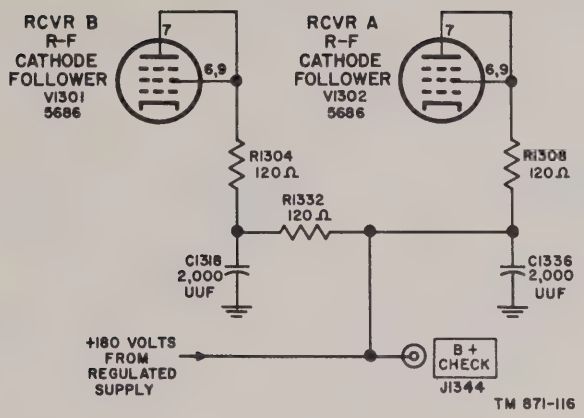


Figure 118. Antenna Coupler CU-286/FRR-33, B+ voltage distribution diagram.

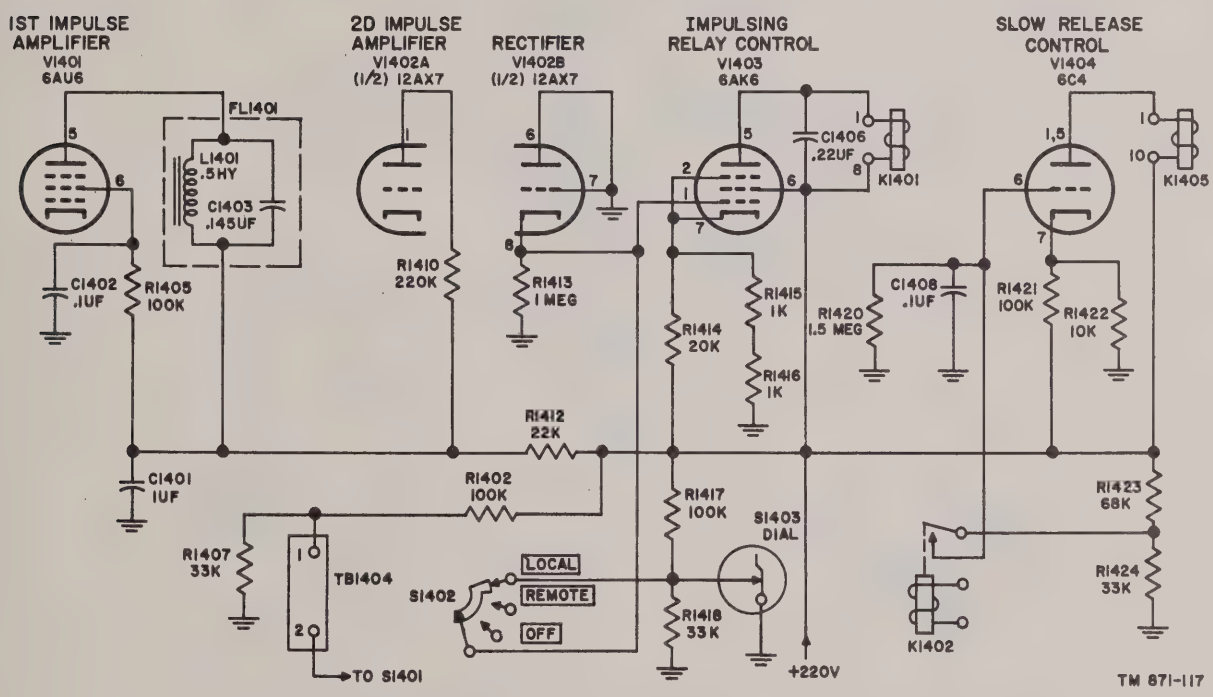


Figure 119. Selector Control C-974/FRR-33, B+ voltage distribution diagram.

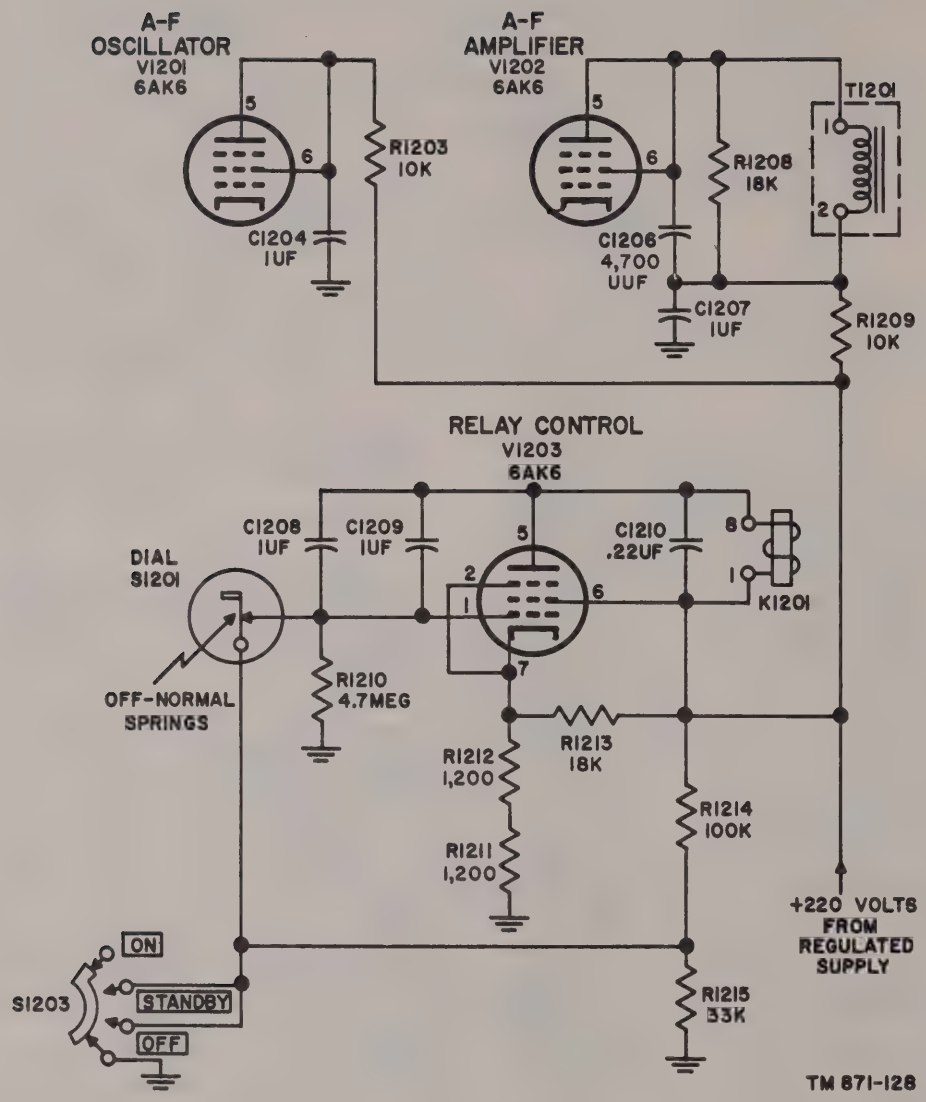
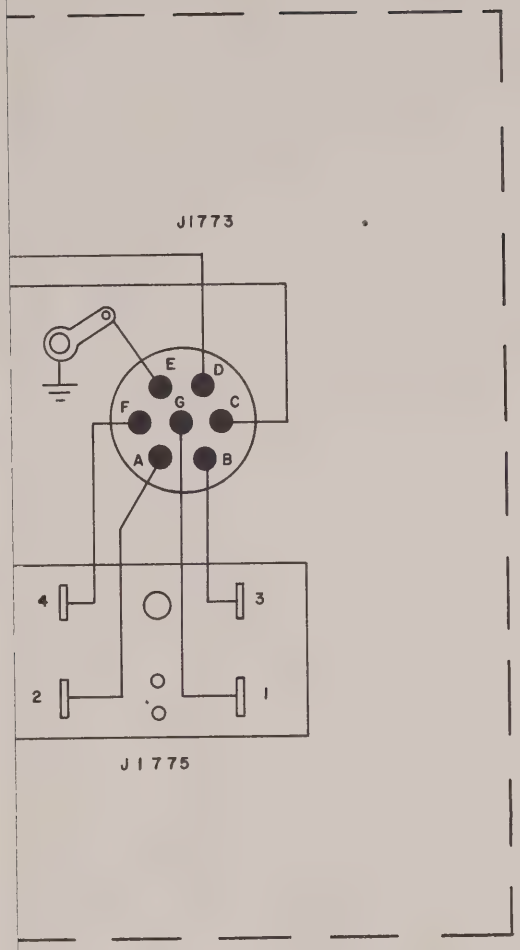


Figure 120. Remote Switching Control C-973/FRR-33, B+ voltage distribution diagram.



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nction box, wiring diagram.

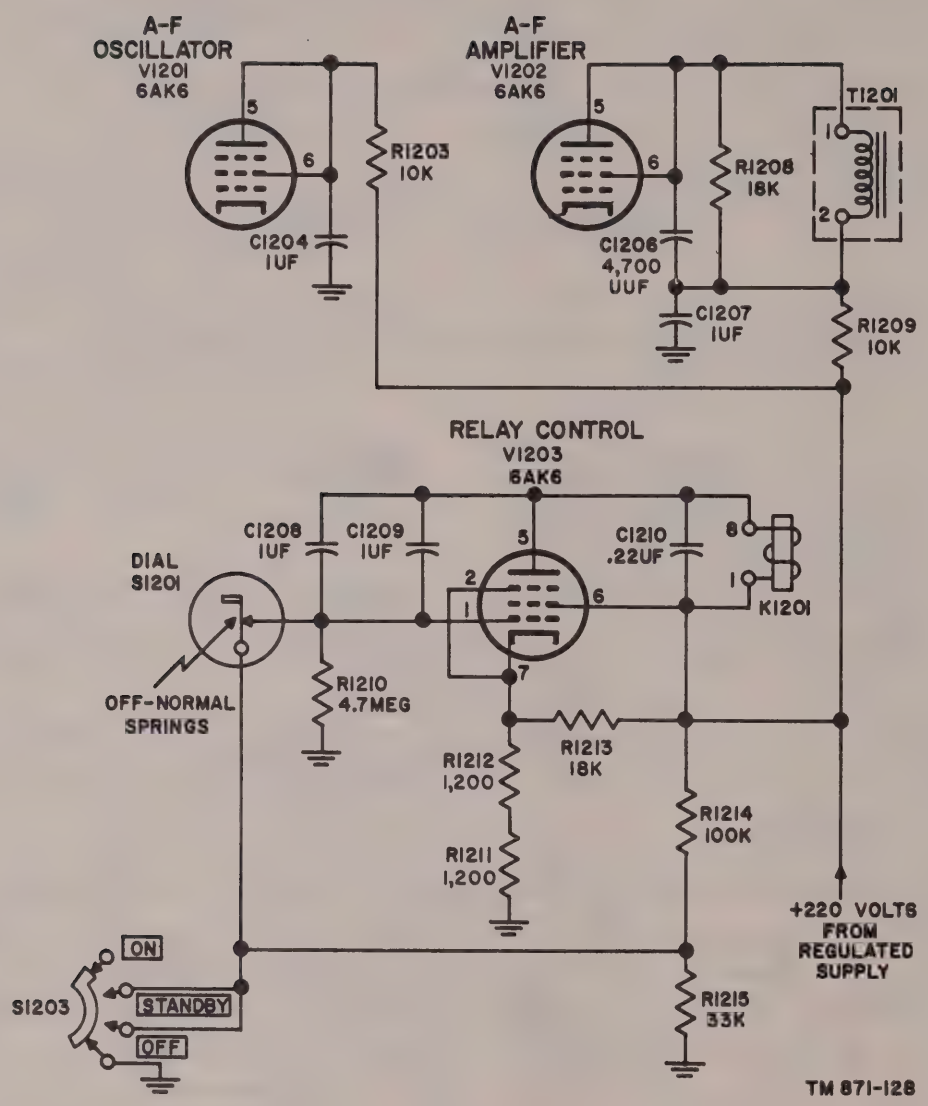


Figure 120. Remote Switching Control C-973/FRR-33, B+ voltage distribution diagram.

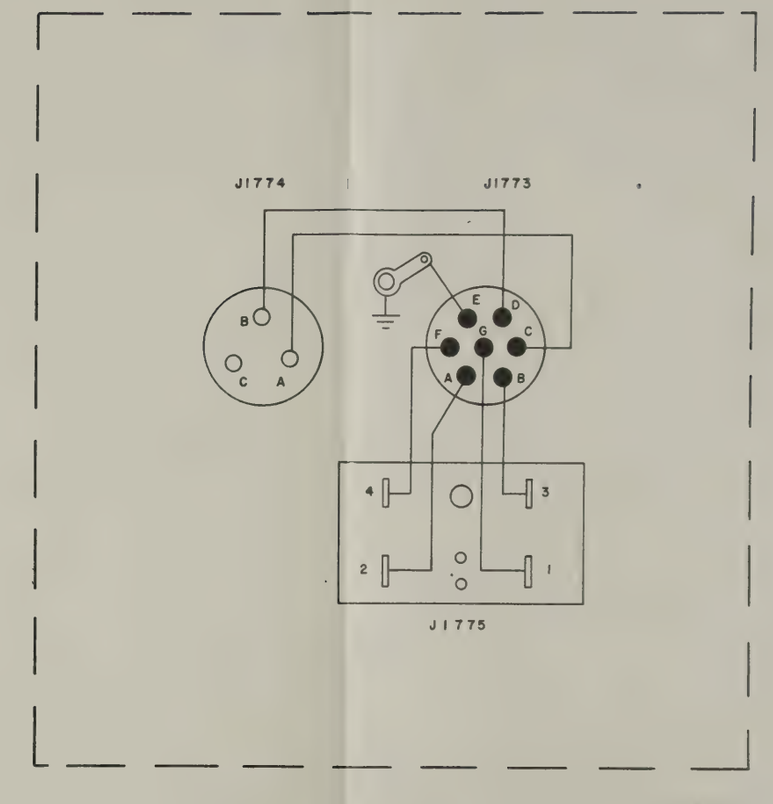
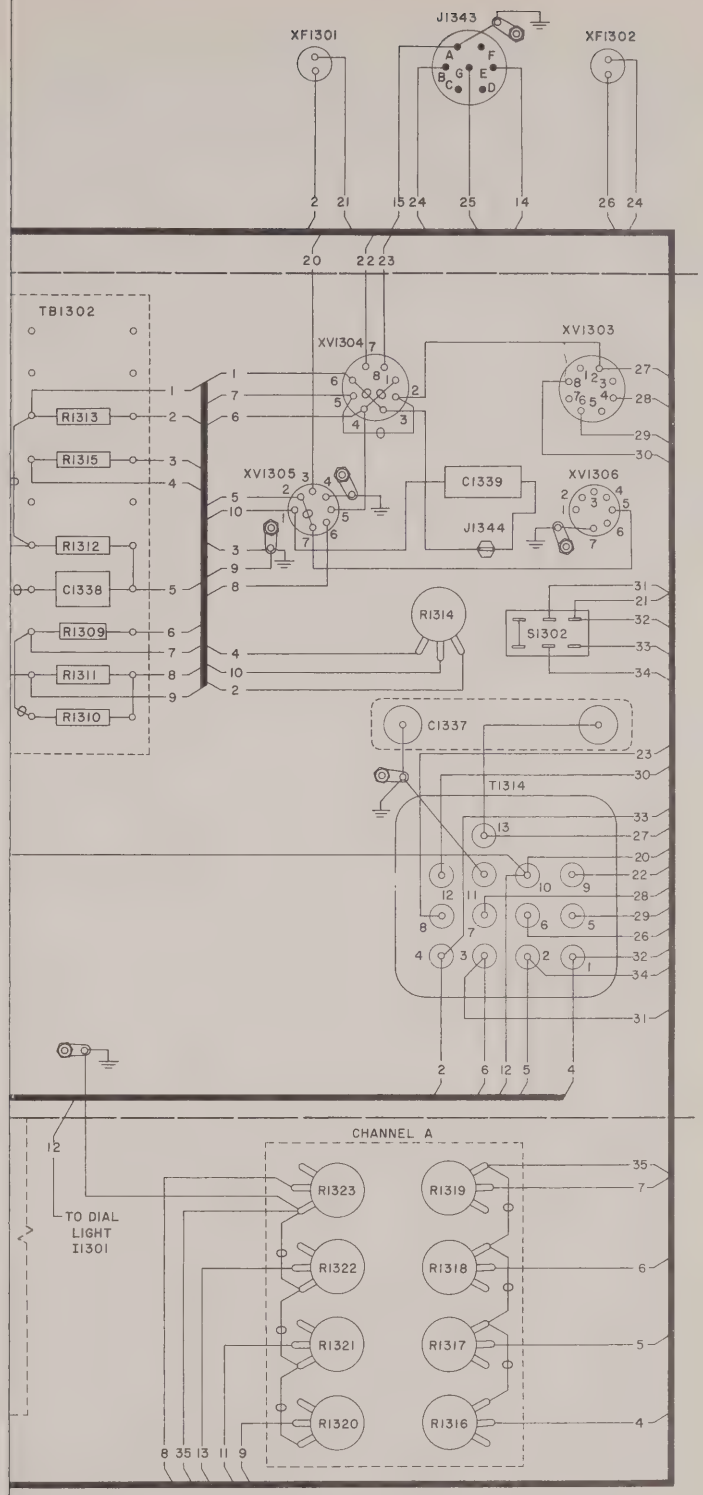


Figure 121. Junction box, wiring diagram.



TM 871-123

er CU-286/FRR-33, wiring diagram.

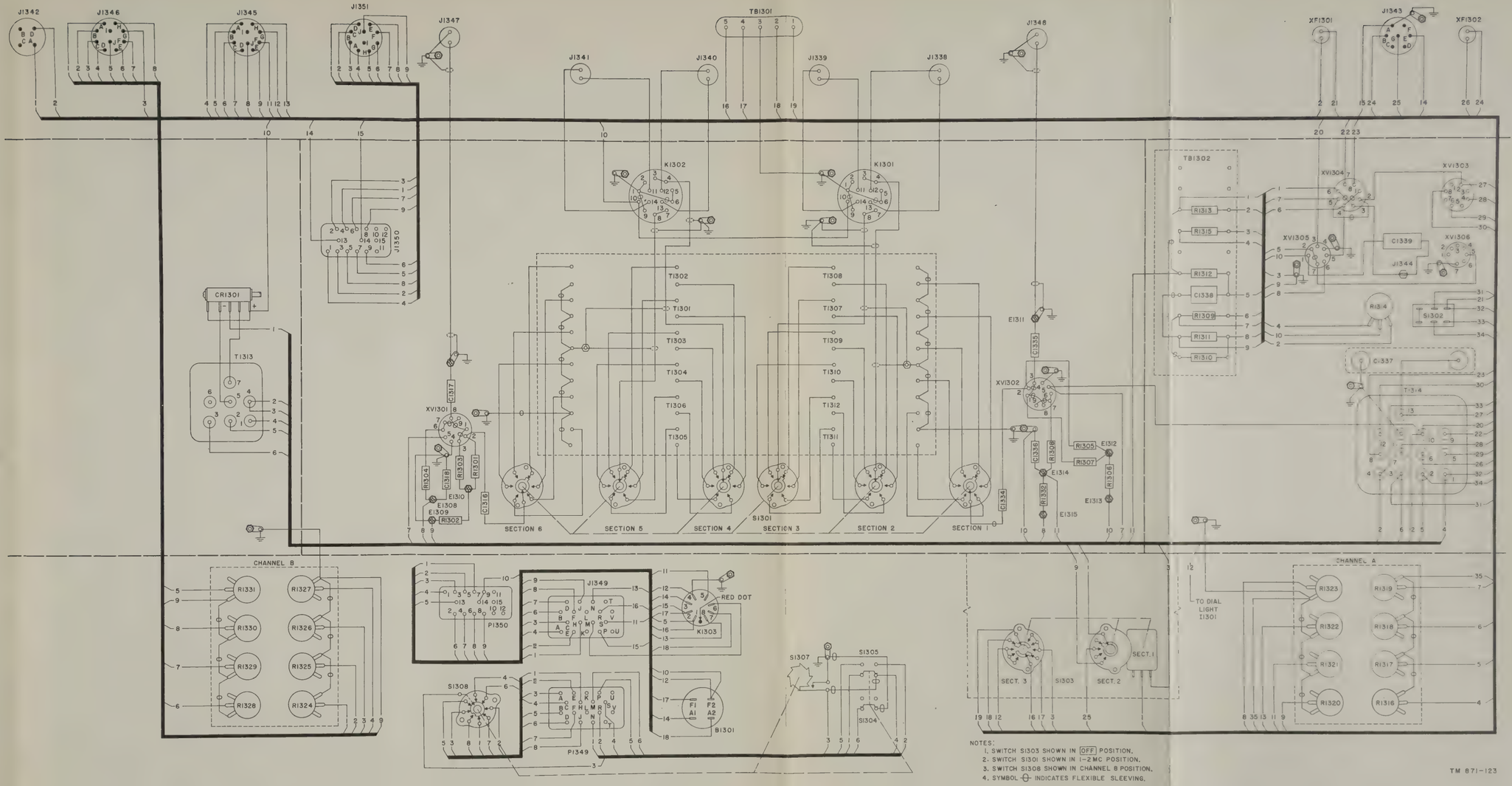


Figure 122. Antenna Coupler CU-286/FRR-33, wiring diagram.

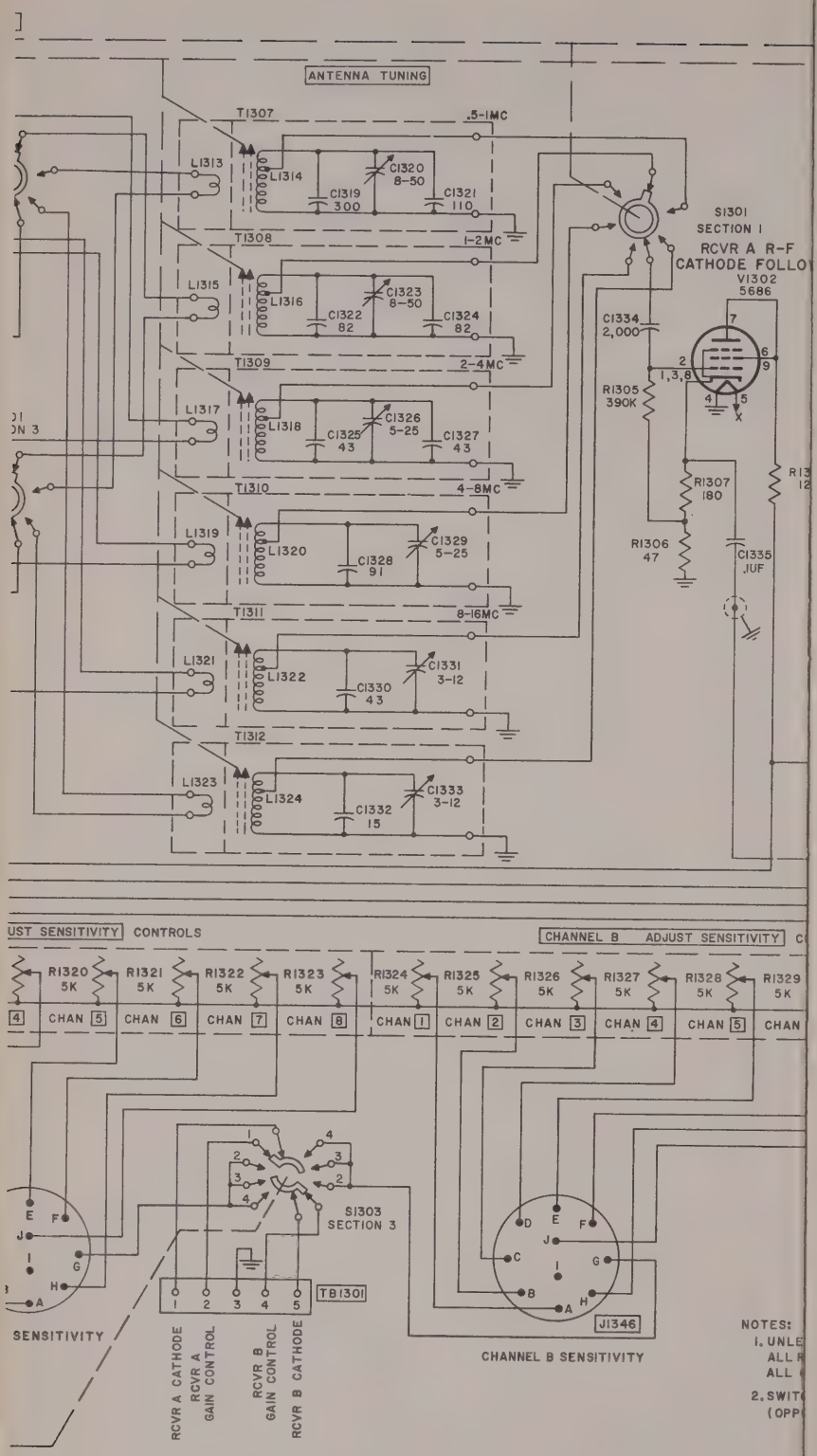


Figure 123. Antenna C

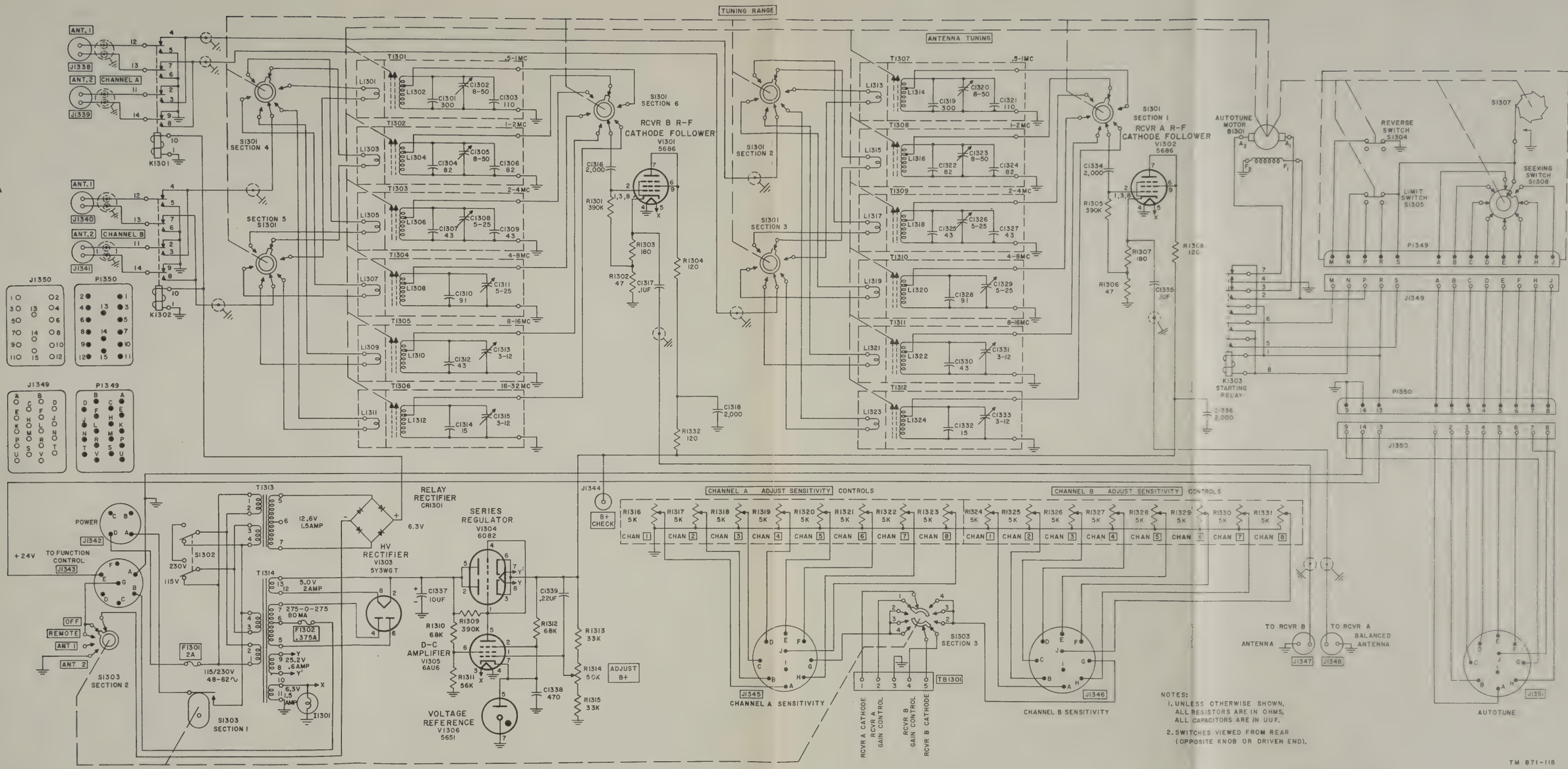


Figure 123. Antenna Coupler CU-286/FRR-33, schematic diagram.

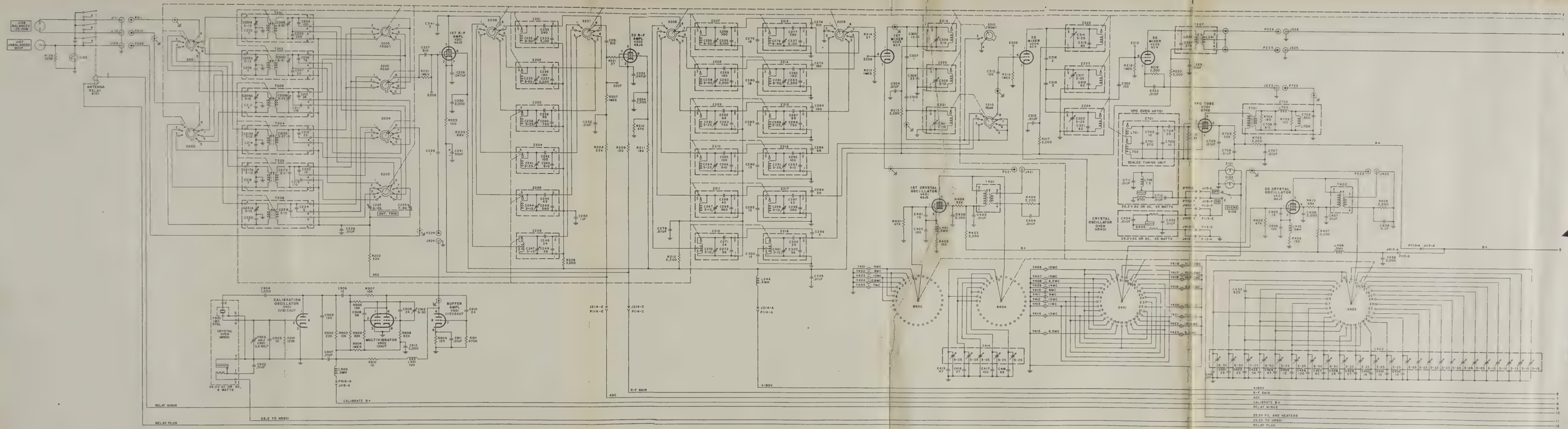
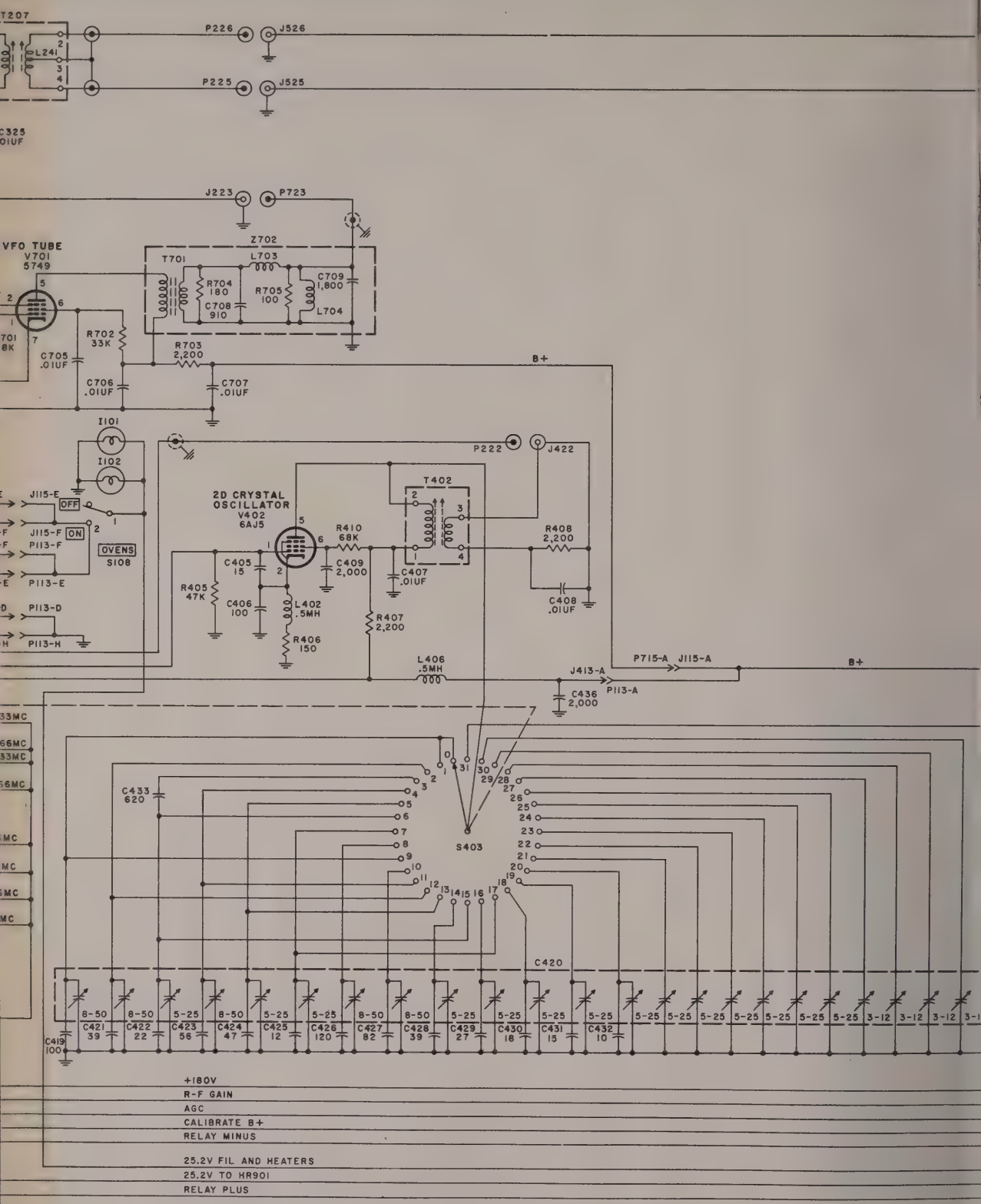


Figure 124. Radio Receiver R-391/URR, schematic diagram.


T207
L241
P226
J526
P225
J525
C325
.01UF
J223
P723
Z702
T701
L703
R704
180
C708
910
R705
100
C709
1,800
L704
VFO TUBE
V701
5749
R702
33K
C705
.01UF
R703
2,200
C706
.01UF
C707
.01UF
B+
I101
I102
P222
J422
T402
2D CRYSTAL
OSCILLATOR
V402
6AJ5
J115-E
OFF
J115-F
ON
P113-F
OVENS
S108
P113-E
P113-D
P113-H
R410
68K
C405
15
C409
2,000
C407
.01UF
R408
2,200
C408
.01UF
R405
47K
C406
100
L402
.5MH
R406
150
R407
2,200
L406
.5MH
P715-A J115-A
J413-A
P113-A
C436
2,000
C433
620
S403
C420
8-50
C421
39
8-50
C422
22
5-25
C423
56
8-50
C424
47
5-25
C425
12
5-25
C426
120
8-50
C427
82
8-50
C428
39
5-25
C429
27
5-25
C430
18
5-25
C431
15
5-25
C432
10
C419
100
+180V
R-F GAIN
AGC
CALIBRATE B+
RELAY MINUS
25.2V FIL AND HEATERS
25.2V TO HR901
RELAY PLUS

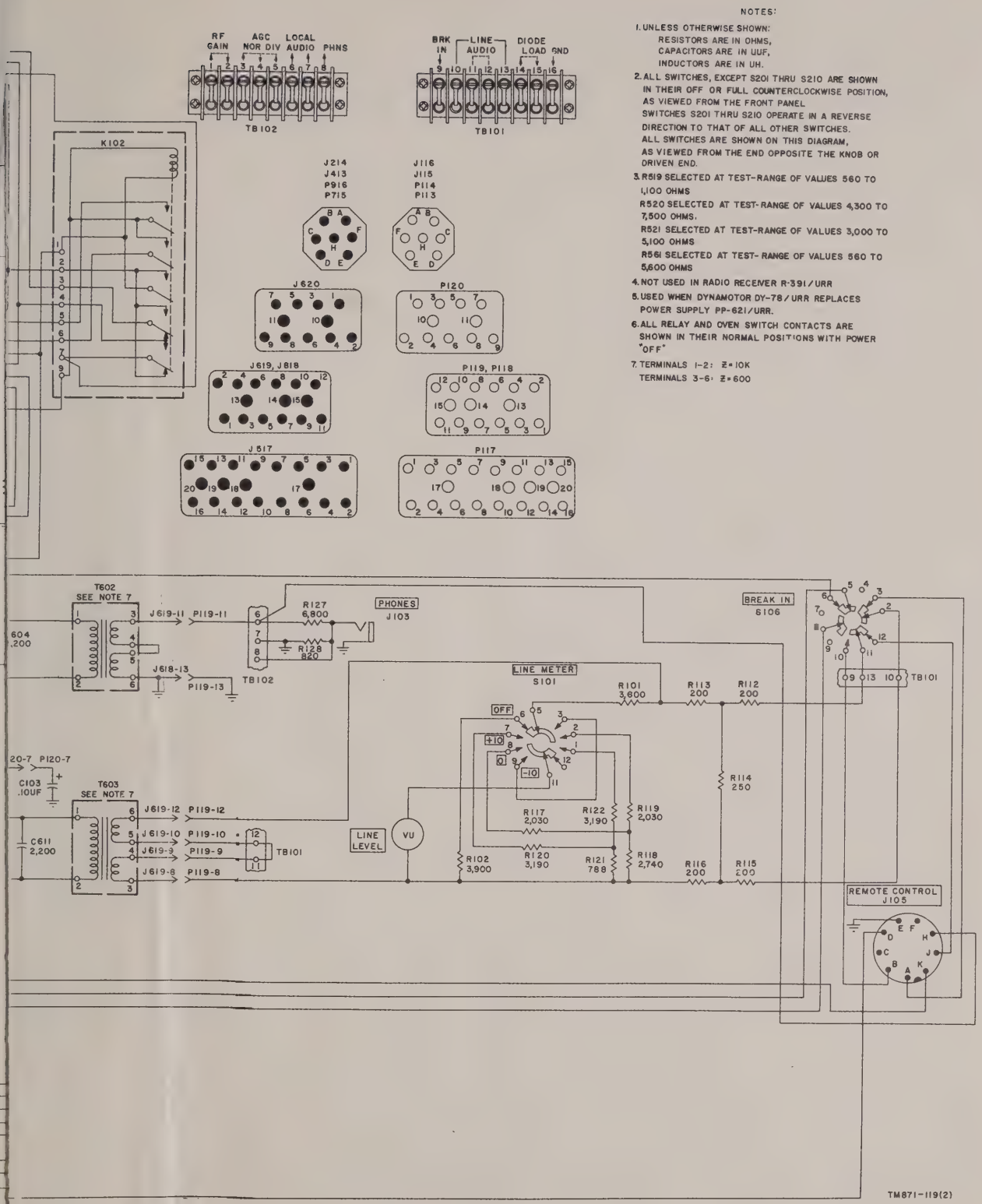
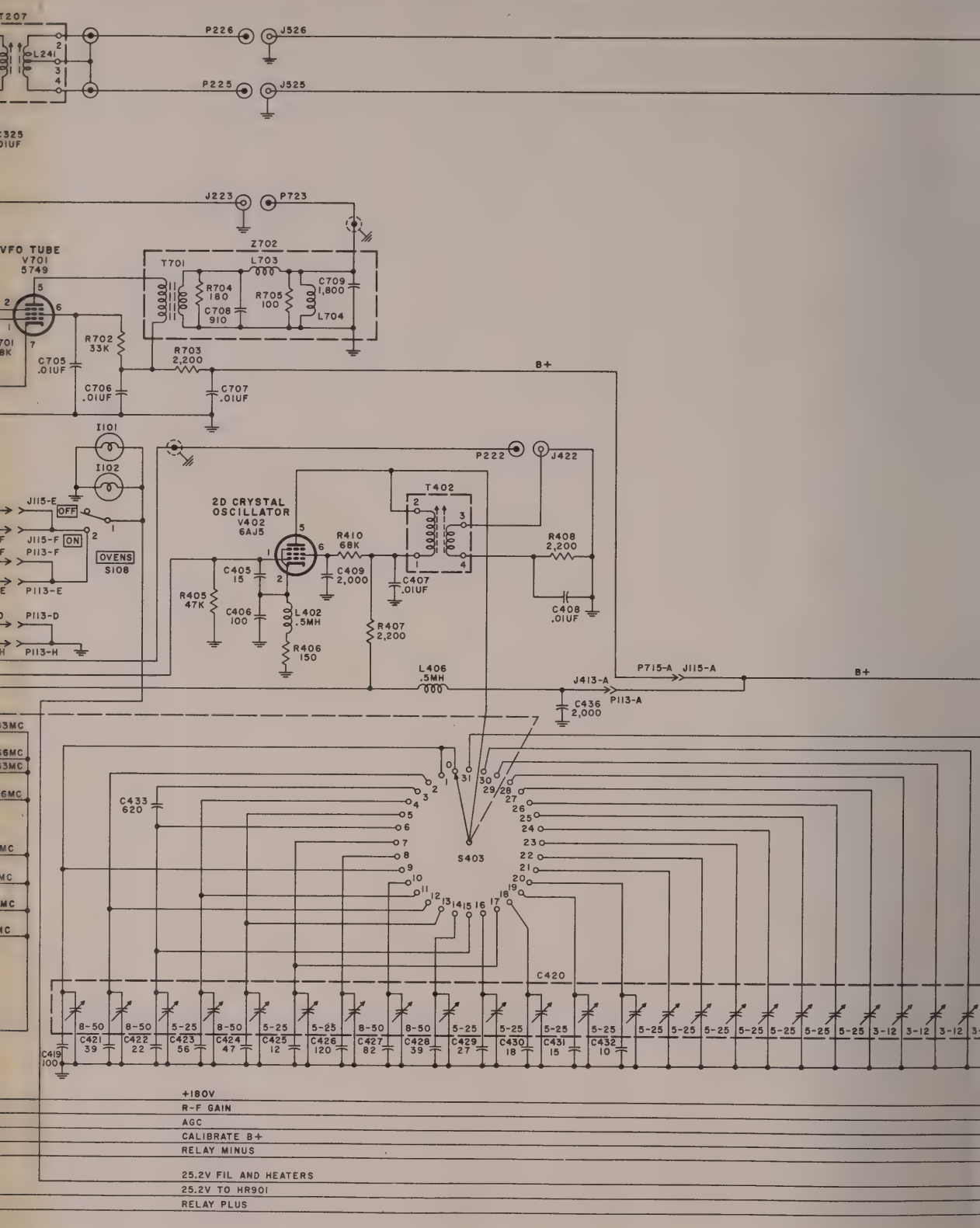
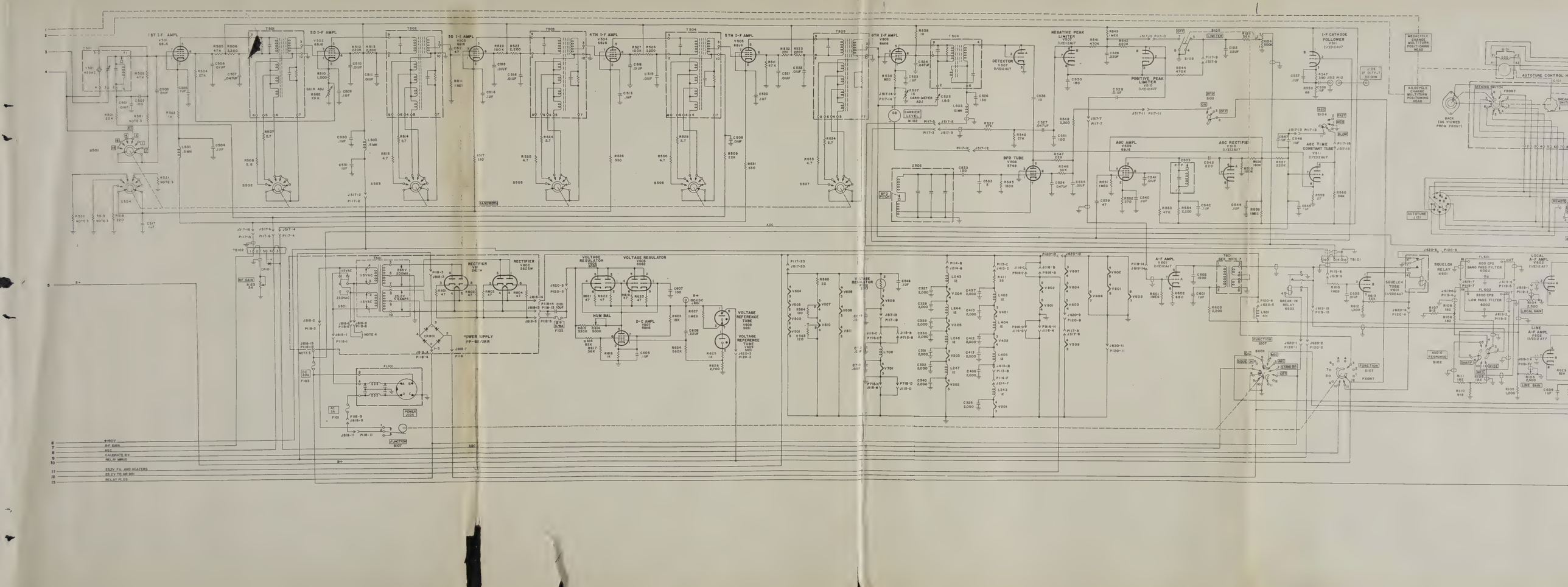


Figure 124. Radio Receiver R-391/URR, schematic diagram.


T207
L24
P226
J526
P225
J525
J223
P723
VFO TUBE
V701
5749
Z702
T701
L703
R704
180
C708
910
R705
100
C709
1,800
L704
R702
33K
C705
.01UF
R703
2,200
C706
.01UF
C707
.01UF
B+
I101
I102
P222
J422
J115-E
OFF
J115-F
ON
P113-F
OVENS
S108
P113-E
P113-D
P113-H
2D CRYSTAL
OSCILLATOR
V402
6AJ5
T402
R410
68K
C405
15
C409
2,000
C407
.01UF
R408
2,200
C408
.01UF
R405
47K
C406
100
L402
.5MH
R406
150
R407
2,200
L406
.5MH
P715-A J115-A
J413-A
P113-A
C436
2,000
C433
620
S403
C420
C419
100
8-50 C421 39
8-50 C422 22
5-25 C423 56
8-50 C424 47
5-25 C425 12
5-25 C426 120
8-50 C427 82
8-50 C428 39
5-25 C429 27
5-25 C430 18
5-25 C431 15
5-25 C432 10
5-25
3-12
+180V
R-F GAIN
AGC
CALIBRATE B+
RELAY MINUS
25.2V FIL AND HEATERS
25.2V TO HR901
RELAY PLUS


1ST I-F AMPL
2ND I-F AMPL
3RD I-F AMPL
4TH I-F AMPL
5TH I-F AMPL
6TH I-F AMPL
NEGATIVE PEAK LIMITER
POSITIVE PEAK LIMITER
I-F CATHODE FOLLOWER
AGC AMPL
AGC RECTIFIER
AGC TIME CONSTANT TUBE
BFO TUBE
DETECTOR
CARRIER METER ADJ
BANDWIDTH
RECTIFIER
VOLTAGE REGULATOR
HUM BAL
D-C AMPL
VOLTAGE REFERENCE TUBE
A-F AMPL
SQUELCH TUBE
SQUELCH RELAY
BREAK-IN RELAY
AUDIO RESPONSE
AUTOTUNE CONTROL
KILOCYCLE CHANGE, MULTITURN POSITIONING HEAD
MEGACYCLE CHANGE, MULTITURN POSITIONING HEAD
BACK (AS VIEWED FROM FRONT)
SEEKING SWITCH
FRONT
RF GAIN
AGC
CALIBRATE B+
RELAY MAKE
25.2V FIL AND HEATERS
25.2V TO HR MO
RELAY PLUS
B+
+150V
POWER SUPPLY PP-82/URR
POWER CORD
FUNCTION SW107
LOCAL GAIN
LINE GAIN
SHARP
MED
WIDE
800 CPS BAND PASS FILTER
LOW PASS FILTER 3500 CPS
LOCAL A-F AMPL
LINE A-F AMPL

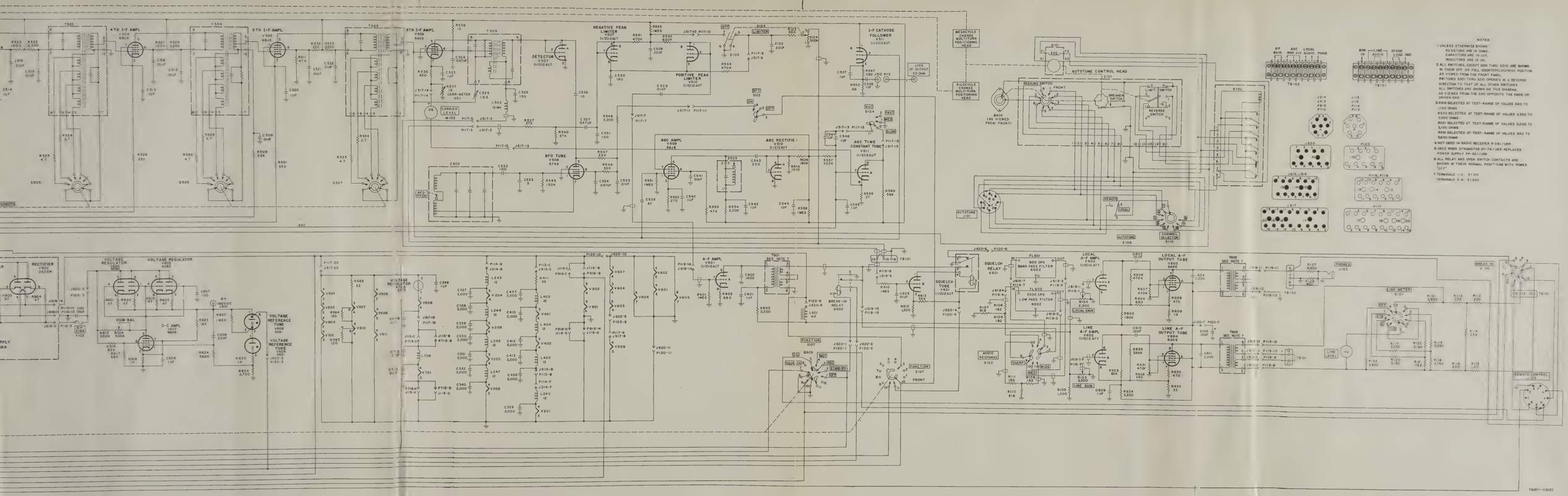
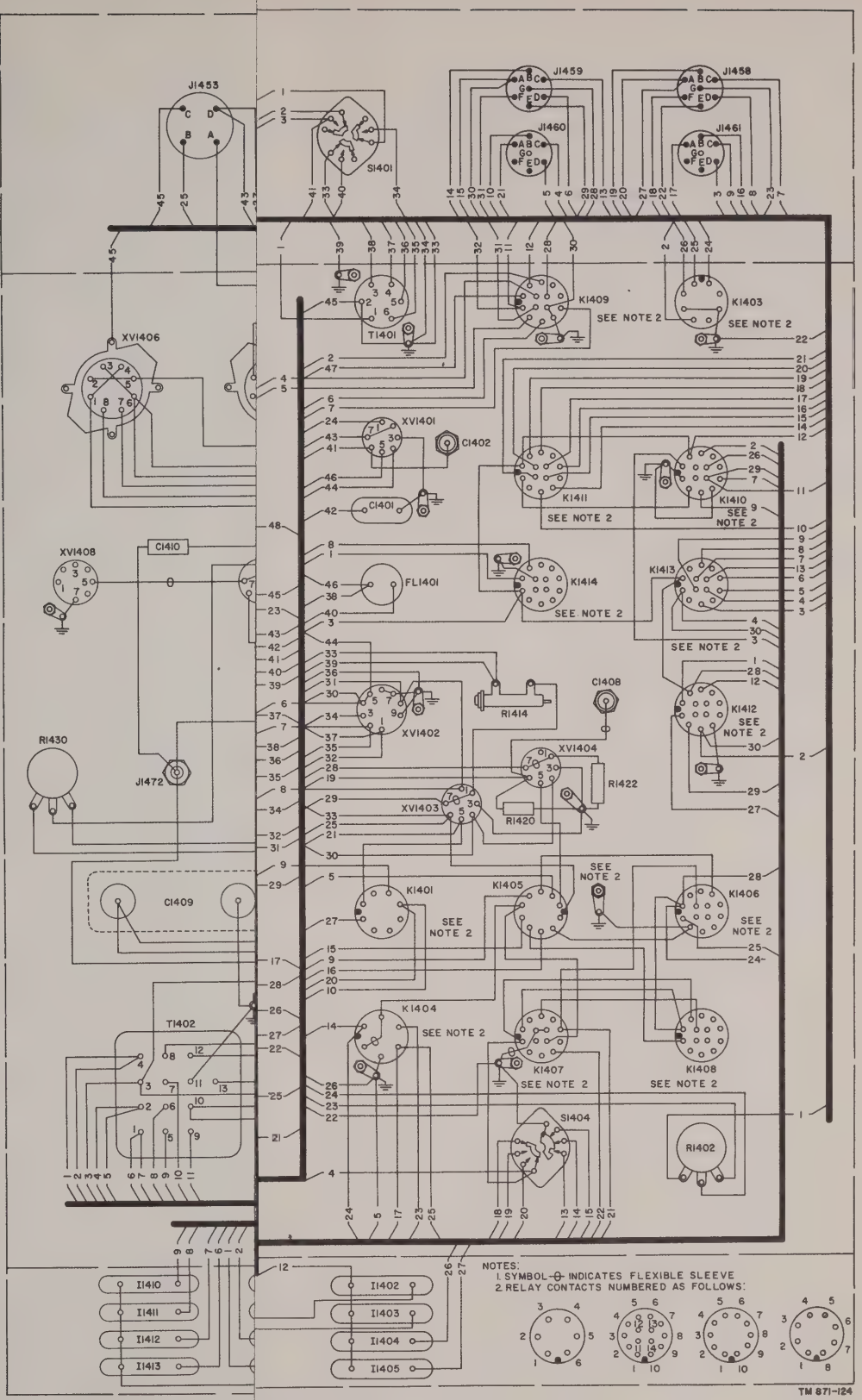


Figure 124. Radio Receiver R-391/URR, schematic diagram.



ontrol C-974/FRR-33, wiring diagram.

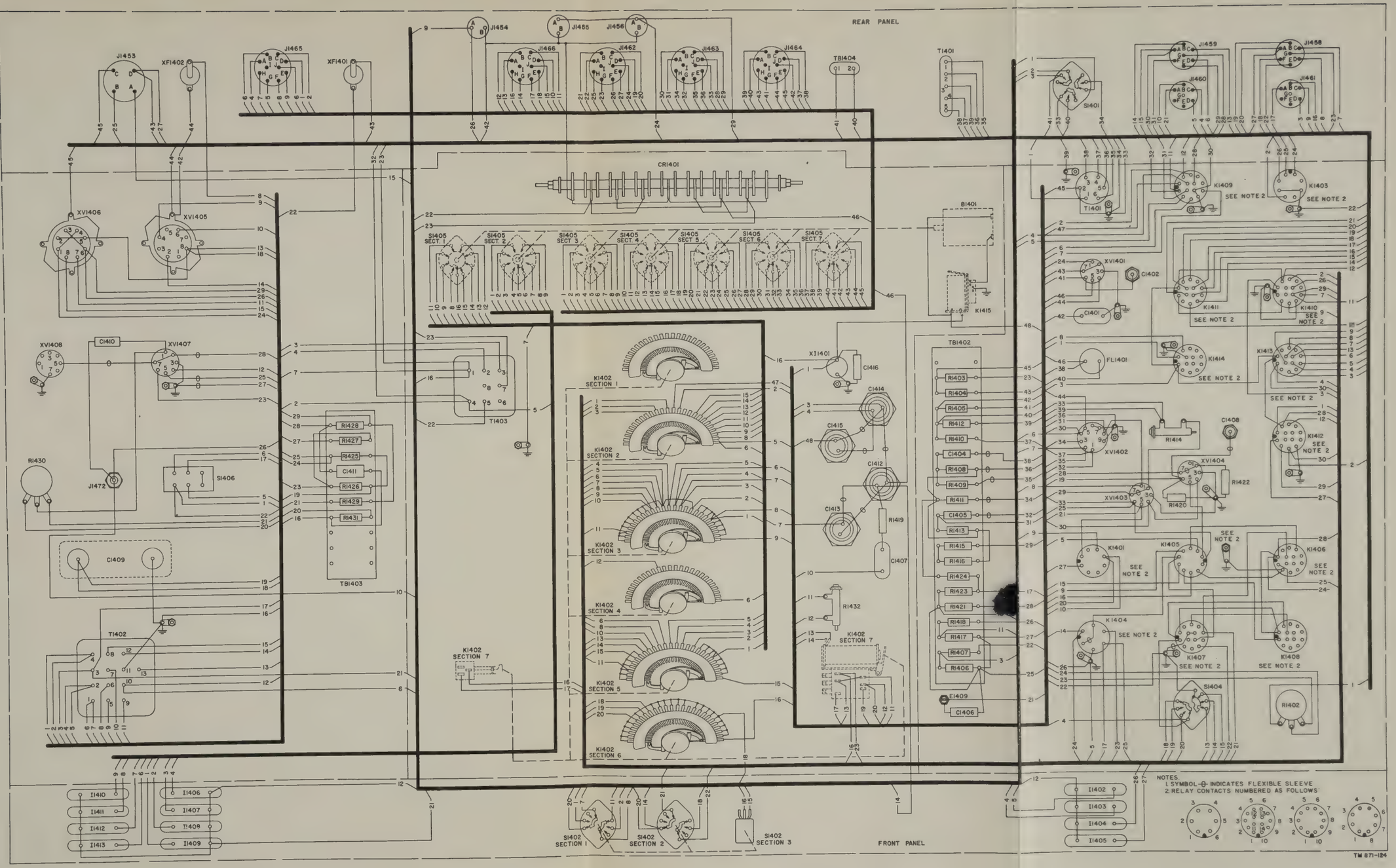


Figure 125. Selector Control C-974/FRR-33, wiring diagram.

	Paragraph	Page
T—*continued*		
Final testing	127	171
Trouble shooting	106	139
Trouble shooting:		
Autopositioner system	111*b*	151
Autotune unit	111*a*	150
Chart	110	147
Checking B+ circuits	107	140
Component sectionalization	104*a*	131
Data	105	132
Equipment performance checklist	69	77
General	65	76
Procedures	104	131
Signal tracing notes	112	152
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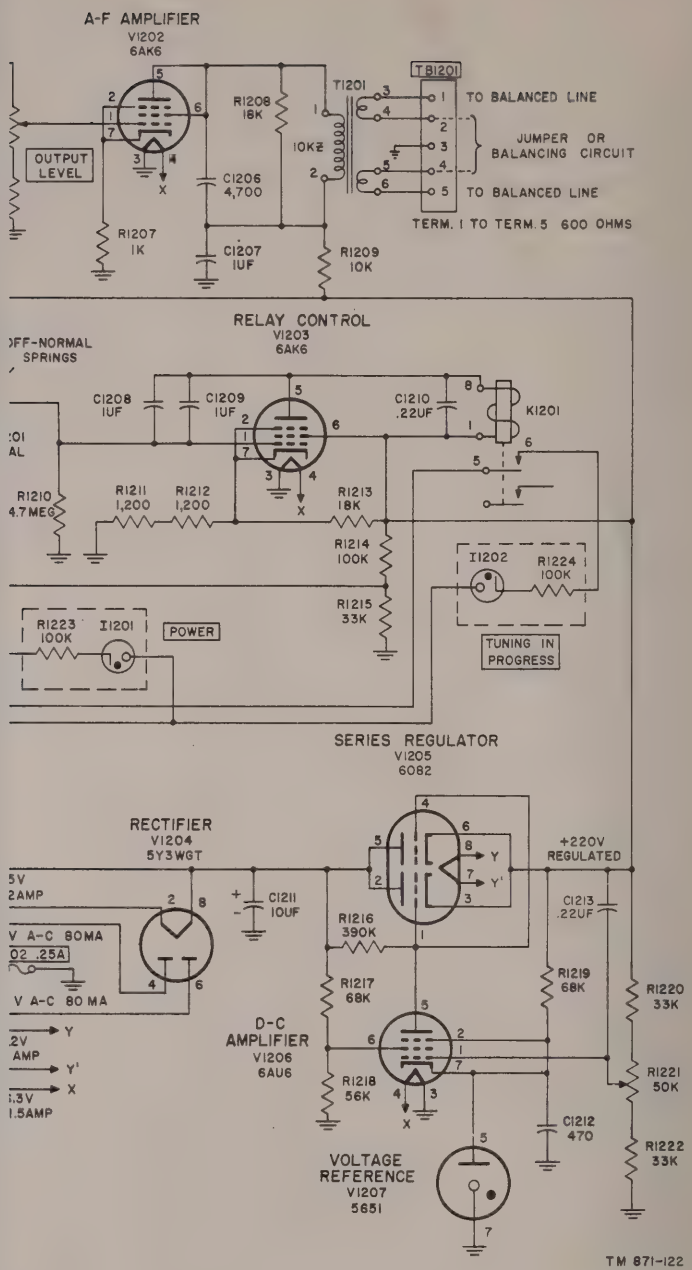


g Control C-973/FRR-33, schematic diagram.

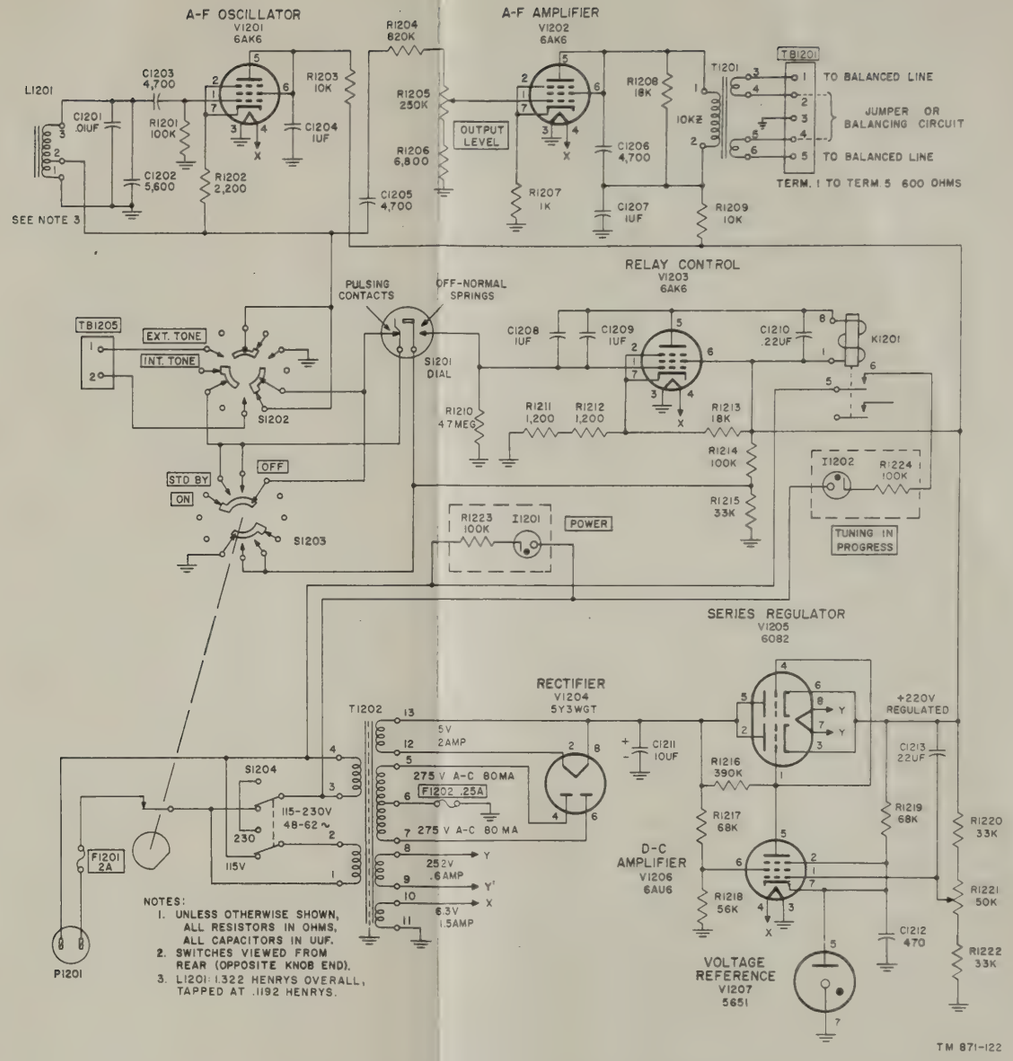
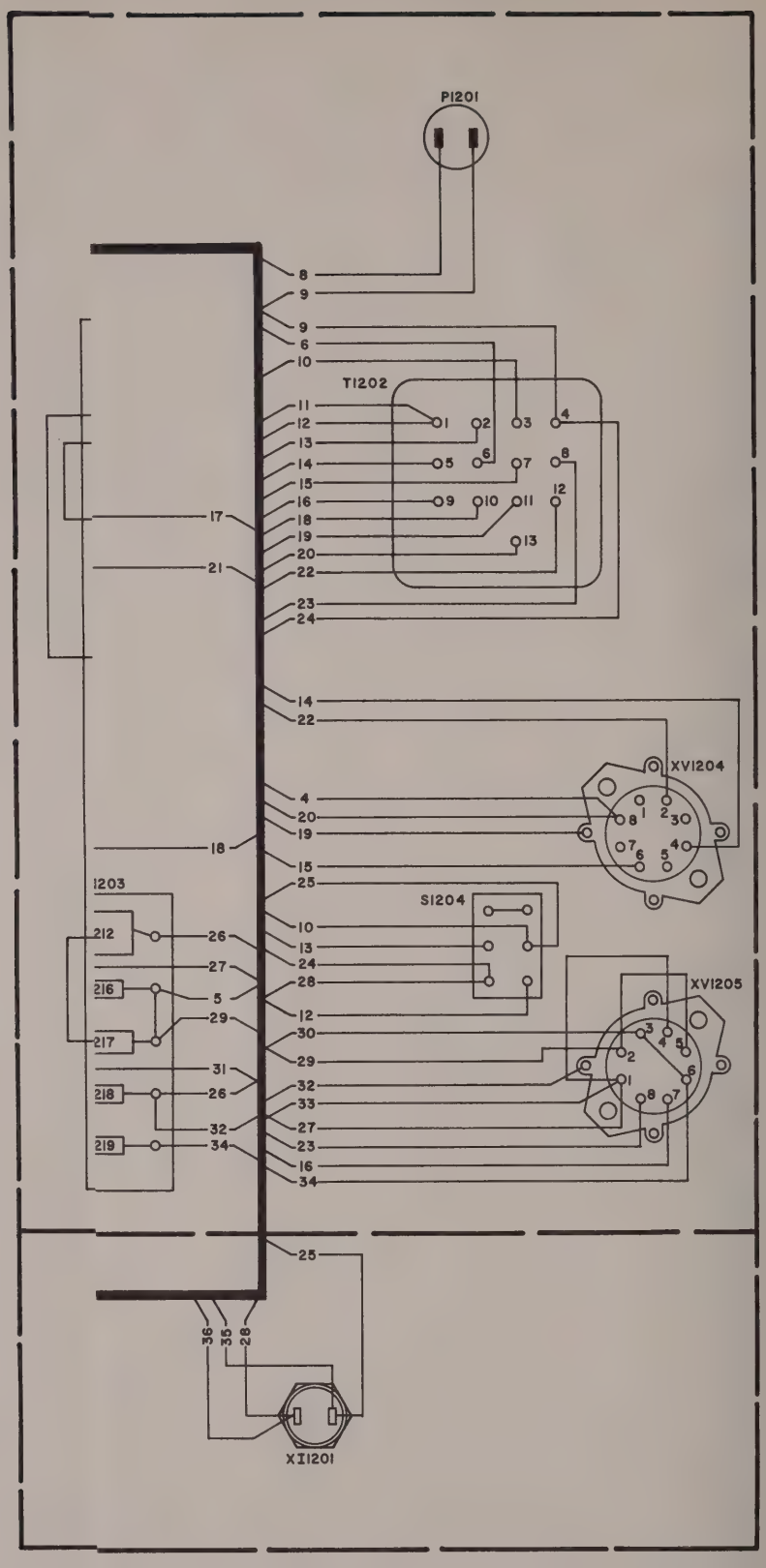


Figure 130. Remote Switching Control C-973/FRR-33, schematic diagram.



g Control C-973/FRR-33, wiring diagram.

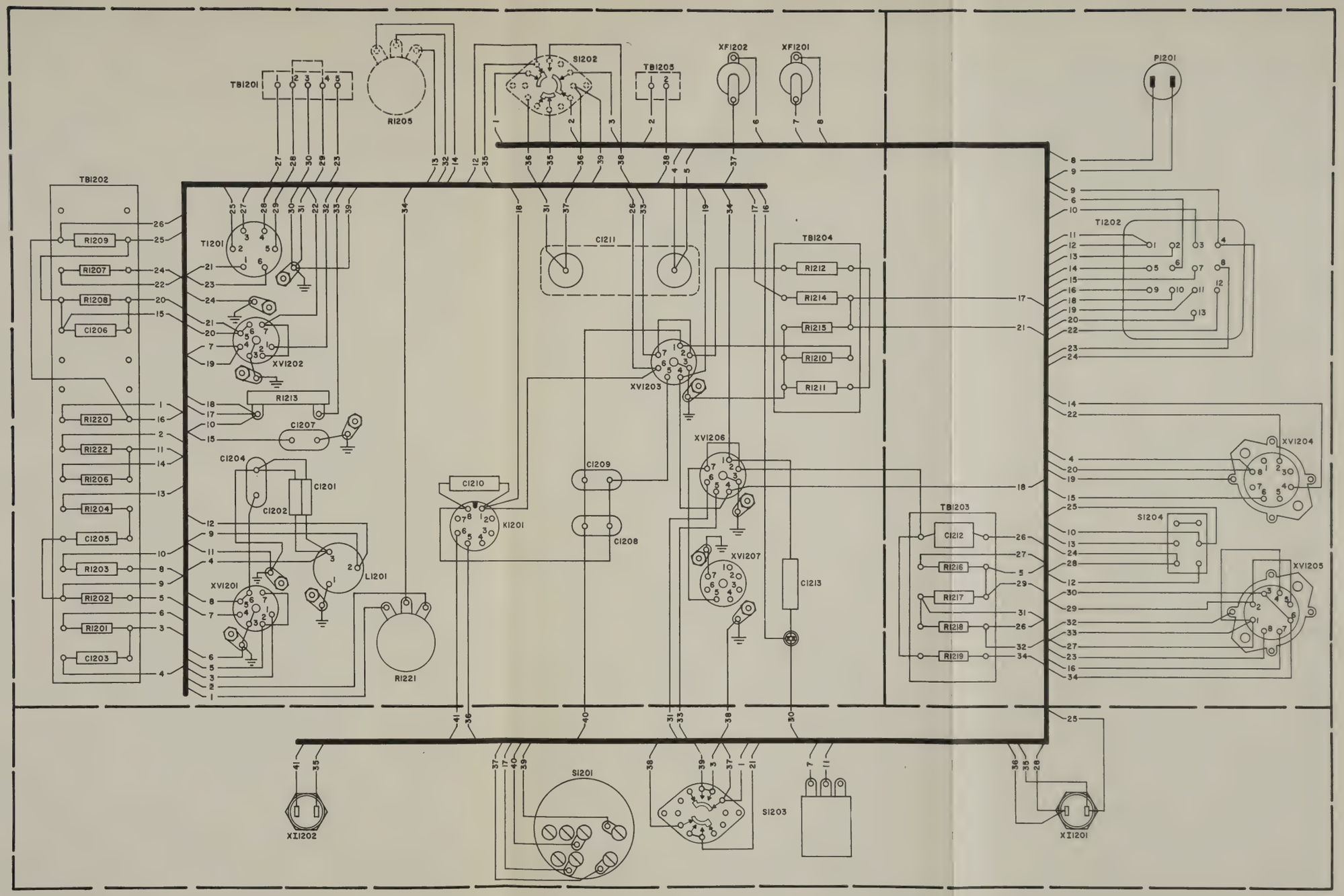


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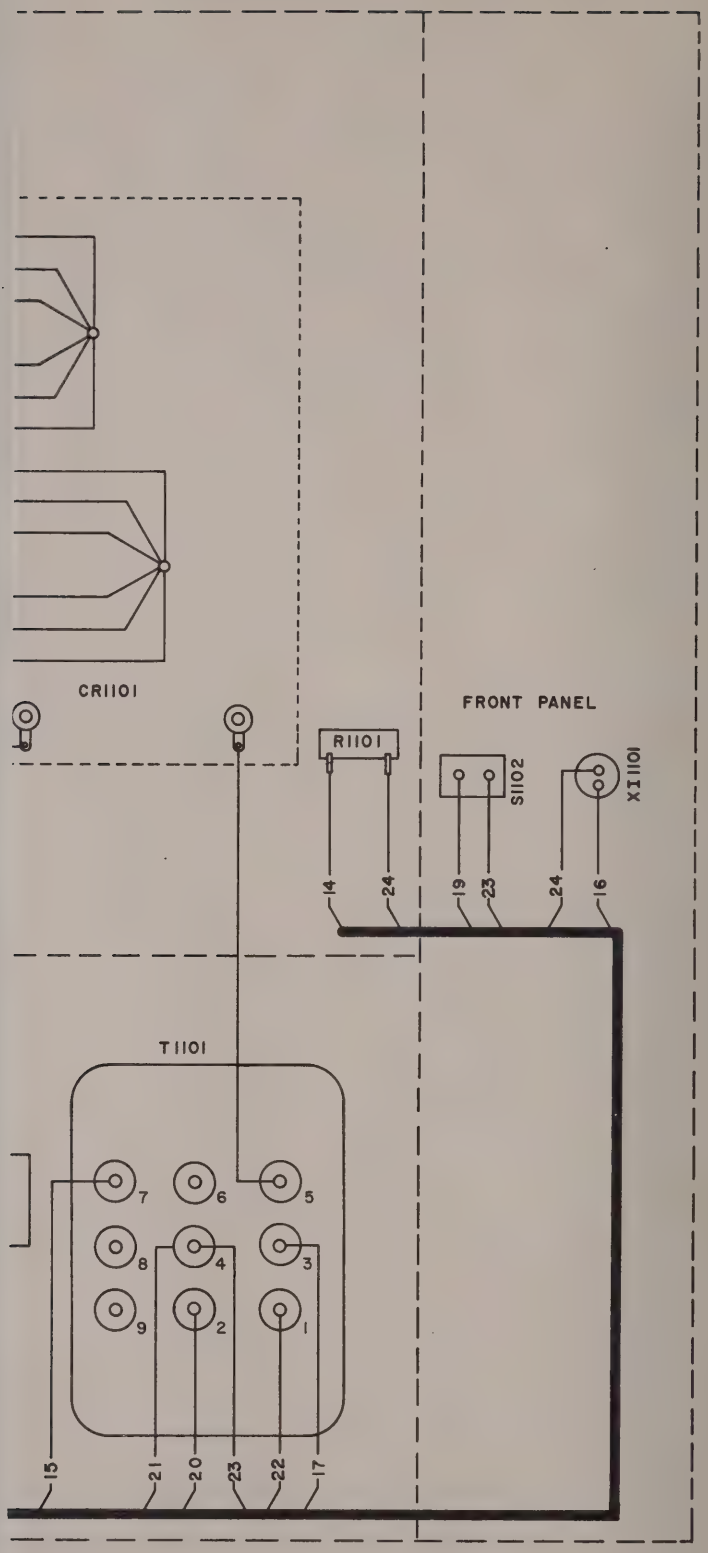
Figure 129. Remote Switching Control C-973/FRR-33, wiring diagram.



ABOL ⏀ INDICATES
EXIBLE SLEEVING

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pply PP-629/URR, wiring diagram.

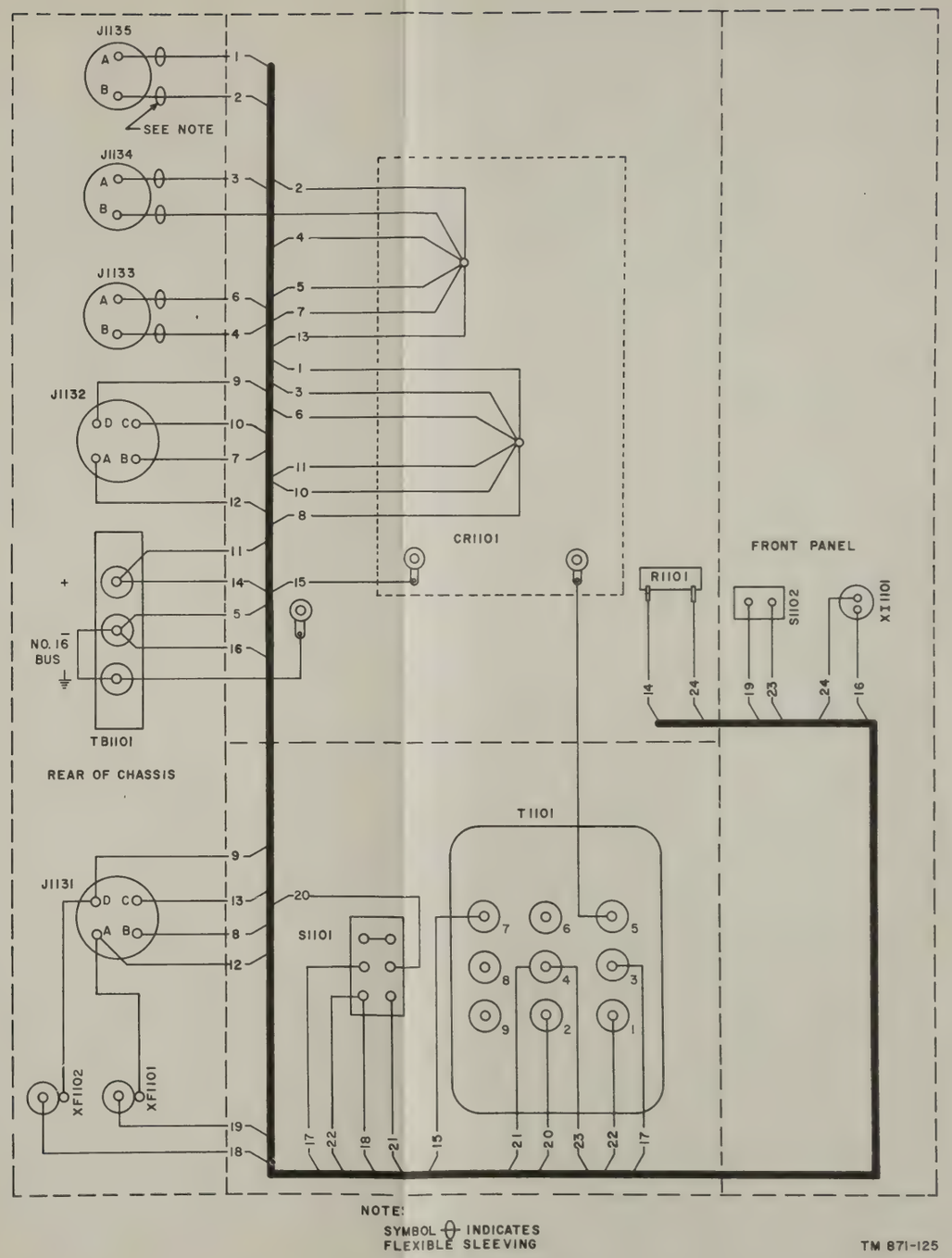

Figure 128. Power Supply PP-629/URR, wiring diagram.

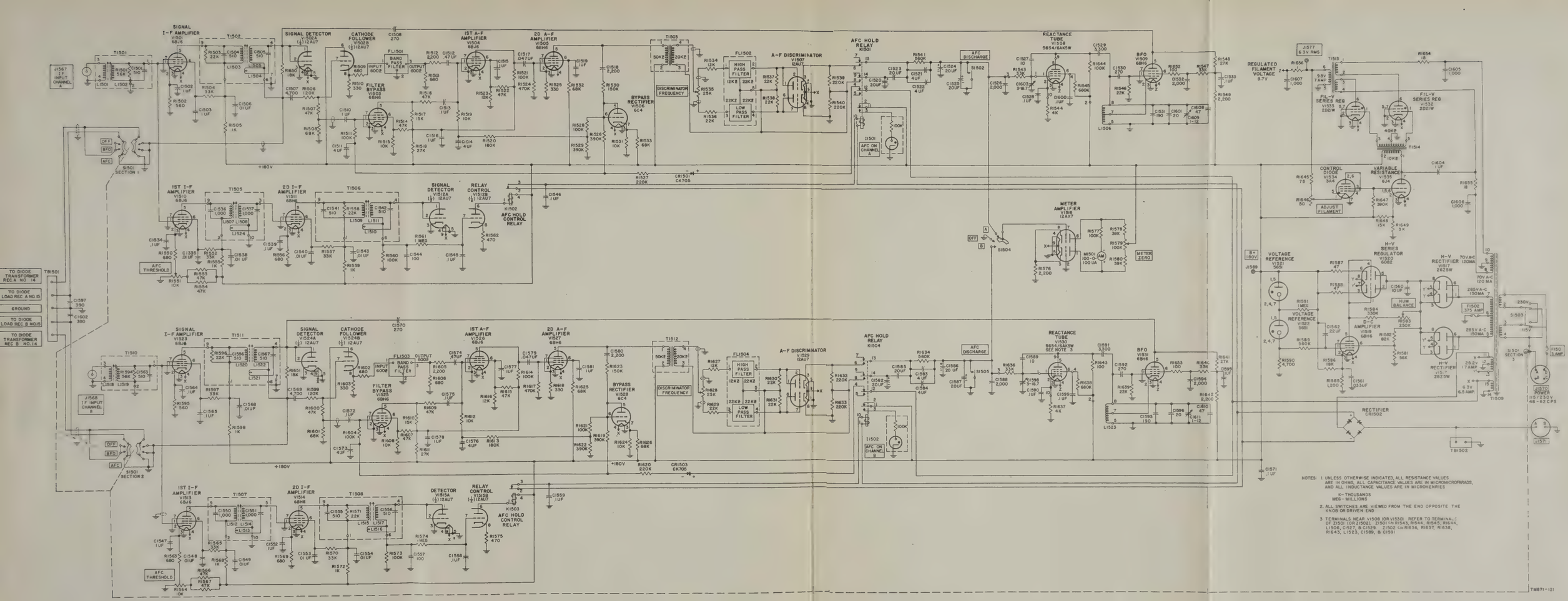
SIGNAL I-F AMPLIFIER V1501 6BJ6
SIGNAL DETECTOR V1502A (½) 12AU7
CATHODE FOLLOWER V1502B (½) 12AU7
FILTER BYPASS V1503 6BH6
IST A-F AMPLIFIER V1504 6BJ6
2D A-F AMPLIFIER V1505 6BH6
BYPASS RECTIFIER V1506 6C4
A-F DISCRIMINATOR V1507 12AU7
AFC HOLD RELAY K1501
REACTANCE TUBE V1508 5654/6AK5W
BFO V1509 6BH6
REGULATED FILAMENT VOLTAGE 9.7V
FIL-V SERIES REG V1532 2D21W
FIL-V SERIES REG V1533 2D21W
CONTROL DIODE V1534 3A4
VARIABLE RESISTANCE V1535 6J4
ADJUST FILAMENT
METER AMPLIFIER V1516 12AX7
METER ZERO
H-V SERIES REGULATOR V1520 6082
H-V RECTIFIER V1517 2623W
H-V RECTIFIER V1518 2623W
VOLTAGE REFERENCE V1521 5651
VOLTAGE REGULATOR V1522 5651
D-C AMPLIFIER V1519 6BH6
HUM BALANCE
RECTIFIER CR1502
F1502 .375 AMP
F1503 3 AMP
F1504 3 AMP
115/230V 48-62 CPS POWER
SIGNAL I-F AMPLIFIER V1523 6BJ6
SIGNAL DETECTOR V1524A (½) 12AU7
CATHODE FOLLOWER V1524B (½) 12AU7
FILTER BYPASS V1525 6BH6
IST A-F AMPLIFIER V1526 6BJ6
2D A-F AMPLIFIER V1527 6BH6
BYPASS RECTIFIER V1528 6C4
A-F DISCRIMINATOR V1529 12AU7
AFC HOLD RELAY K1504
REACTANCE TUBE V1530 5654/6AK5W SEE NOTE 3
BFO V1531 6BH6
IST I-F AMPLIFIER V1513 6BJ6
2D I-F AMPLIFIER V1514 6BH6
DETECTOR V1515A (½) 12AU7
RELAY CONTROL V1515B (½) 12AU7
AFC HOLD CONTROL RELAY K1503
IST I-F AMPLIFIER V1510 6BJ6
2D I-F AMPLIFIER V1511 6BH6
SIGNAL DETECTOR V1512A (½) 12AU7
RELAY CONTROL V1512B (½) 12AU7
AFC HOLD CONTROL RELAY K1502
AFC THRESHOLD
DISCRIMINATOR FREQUENCY
BAND PASS FILTER
HIGH PASS FILTER
LOW PASS FILTER
AFC DISCHARGE
AFC ON CHANNEL A
AFC ON CHANNEL B
OFF
BFO
AFC
J1567 I-F INPUT CHANNEL A
J1568 I-F INPUT CHANNEL B
TO DIODE TRANSFORMER REC A NO 14
TO DIODE LOAD REC A NO 15
GROUND
TO DIODE LOAD REC B NO 15
TO DIODE TRANSFORMER REC B NO 14
+180V
B+ 180V
J1577 6.3V RMS
J1569
J1570
J1571
TB1501
TB1502
S1501 SECTION 1
S1501 SECTION 2
S1501 SECTION 3
S1502
S1503
S1504
S1505
NOTES: 1. UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFRADS, AND ALL INDUCTANCE VALUES ARE IN MICROHENRIES
K-THOUSANDS
MEG-MILLIONS
2. ALL SWITCHES ARE VIEWED FROM THE END OPPOSITE THE KNOB OR DRIVEN END
3 TERMINALS NEAR V1508 (OR V1530) REFER TO TERMINAL 2 OF Z1501 (OR Z1502). Z1501 ON R1543, R1544, R1545, R1644, L1506, C1527, & C1529. Z1502 ON R1636, R1637, R1638, R1643, L1523, C1589, & C1591
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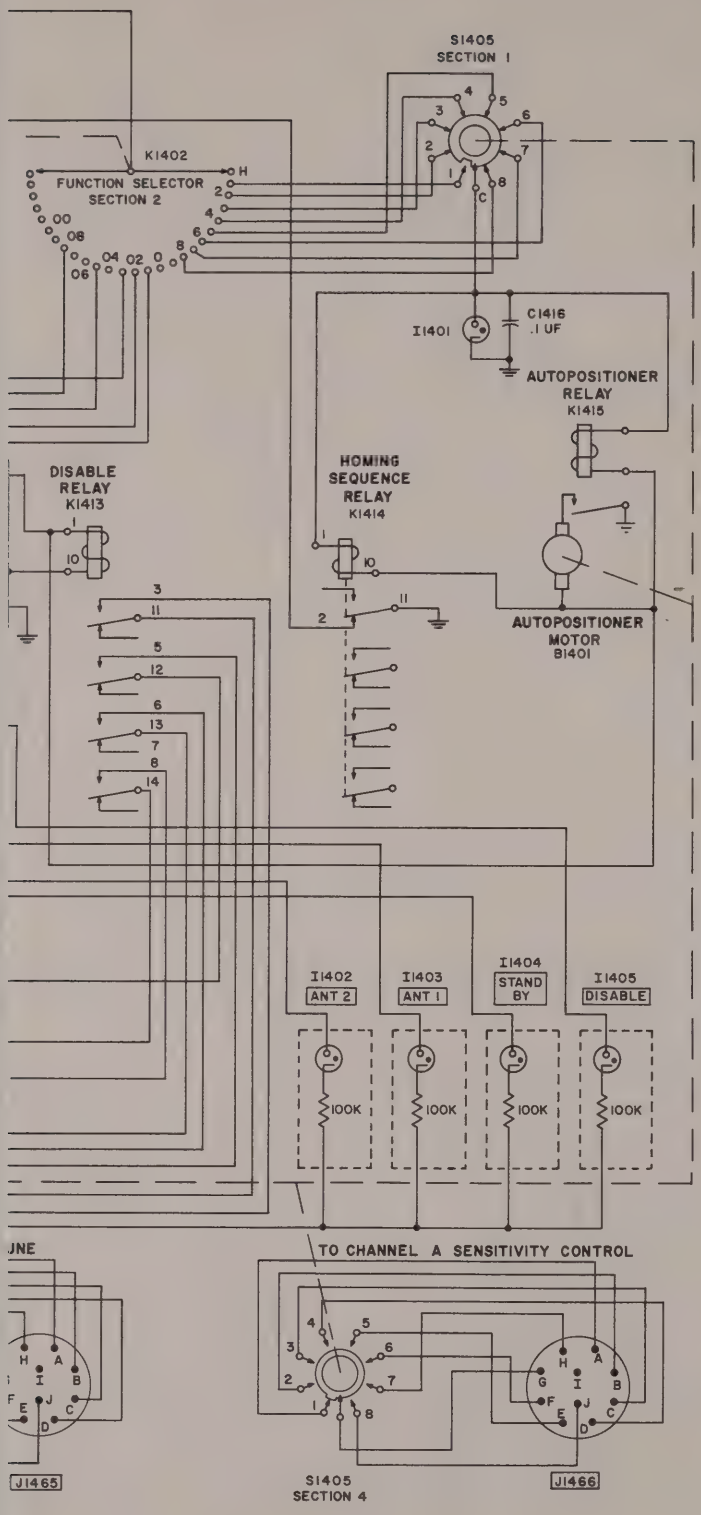
Figure 127. Receiver Control C-975/URR, schematic diagram.



NOTES:

1. TERMINALS 2 AND 4 JUMPERED IF BALANCING NETWORK IS NOT USED.
2. UNUSED SECTION 1 OF K1402 IS NOT SHOWN.
3. UNLESS OTHERWISE SHOWN, ALL RESISTORS IN OHMS, ALL CAPACITORS IN UUF.

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Figure 126. Selector Control C-974/FRR-33, schematic diagram.

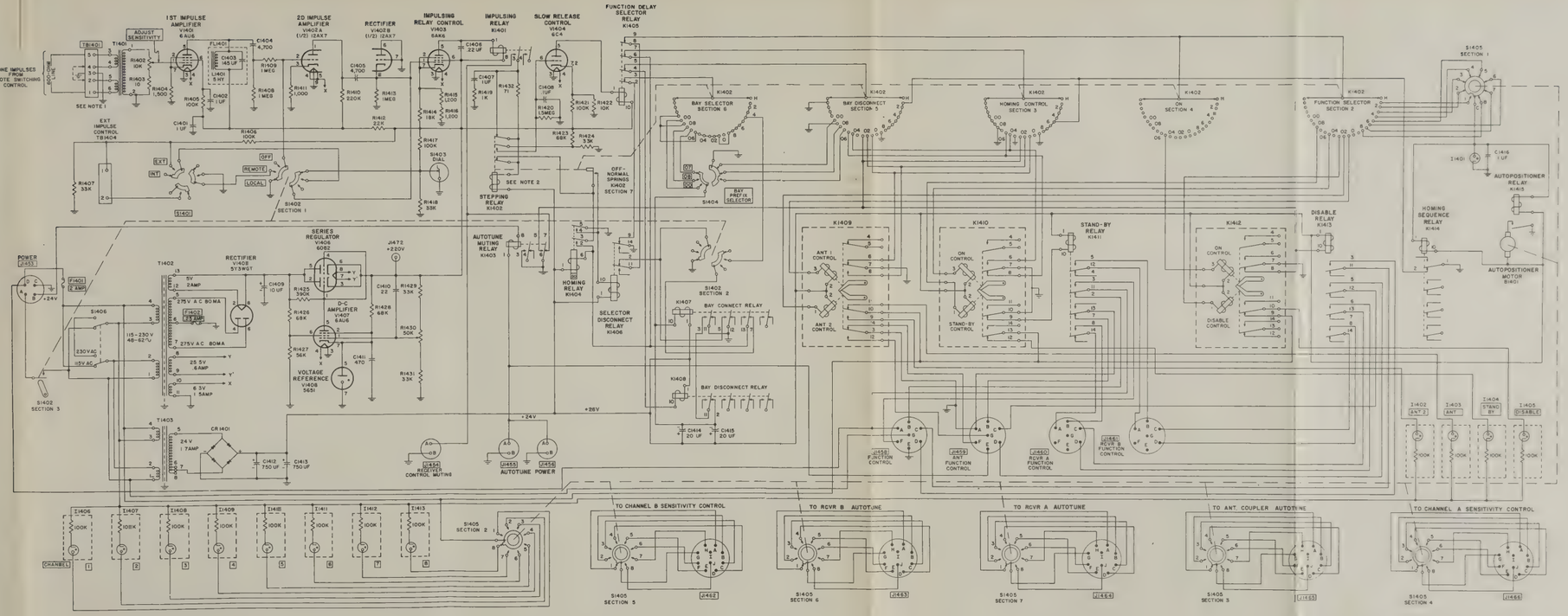

Figure 126. Selector Control C-974/FRR-33, schematic diagram.